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In Two Sections
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Toward a Generalized Break-Even Formula

by WILLIAM J. VATTER

A WELL-ESTABLISHED approach to understanding the impacts of cost behavior and revenue upon profits, the break-even chart, like most other tools used by businessmen, is not perfect, though its usefulness serves to excuse its imperfections. Despite the theoretical shortcomings of the break-even analysis,[1] it has and does serve as a managerial and analytic tool for better understanding of business costs, revenue and profit data.

The recent growth of interest in "direct-costing" techniques, in which a careful separation is maintained between variable and fixed costs—even to the extent of measuring income by this approach—has had direct relevance to the current application of break-even analysis. Indeed, some time ago, the relations between "variable-costing" techniques and break-even calculation were pointed out.[2] However, one of the stumbling blocks of break-even analysis has been the failure to make clear just how and where conventional income is different from "break-even" income. Even though there have been authoritative positions taken with respect to the use of variable costing for financial reporting purposes,[3] it is important that these differences be recognized and understood. Such a result, the present writer believes, has not been achieved yet.

One reason for my belief that direct-costing, the flexible-budget, and break-even analysis are not well understood is the problem that comes up whenever, as it often happens, conventional income computation (absorption-cost basis) is thrown against break-even or flexible-budget analysis. The trouble lies, of course, in the area of inventories; since conventional costing carries fixed costs through inventories, and income is therefore affected by the change in the amount of fixed costs in inventories at the beginning and end of the period,[4]

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[1] "Cost Structures of Enterprises and Break-Even Charts," Joel Dean, *American Economic Review, Papers and Proceedings,* May 1948.

[2] "Advantages of the 'Break-even' Income Statement," Alexander Bac, *Journal of Accountancy,* January 1951.

[3] "Accounting and Reporting Standards for Corporate Financial Statements, 1957 Revision," American Accounting Association Committee on Concepts and Standards, *Accounting Review,* October 1957.

[4] This, of course, means that the incomes of two adjacent periods are doubly affected by this factor. See "Reported Income and Inventory Change," George H. Sorter, *Journal of Business,* January 1959.

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there is a difference between conventional absorption-costing and variable-costing income determination. If the final inventory contains more dollars of allocated fixed cost than the initial inventory, the income computed by absorption costing will be higher than that shown by a variable-costing approach. If the initial inventory contains the larger amount of fixed cost, the reverse is true, and conventional (absorption-cost) income will be smaller than that computed by variable-costing procedures. This fact is the basis for considerable confusion in the area of comparing break-even, flexible-budget income with conventional calculations. The break-even chart is drawn (and thought of) as applicable to the case in which production volume equals sales volume of the period. Confusion results when, as is typically the case, inventories change the picture.

Also of some relevance (especially for interim statements) is the effect of over- or under-absorbed costs in this situation. Conventionally calculated normal absorption costs do not necessarily apply all the manufacturing costs to product, for a number of reasons too detailed for discussion here.[5] As a result, there is another effect upon income, which depends on whether the over- or under-absorbed balance is carried as a deferred charge, absorbed completely in profit and loss, or prorated over inventories and cost of goods sold. The same problem and effects arise from various kinds of standard-cost "variances" for similar reasons.

The confusion that has thus far been only hinted at is this: A break-even chart shows one break-even point and a separate income figure for every level of operation over some limited range of volume. When a conventional income statement is compared to the break-even figures, the differences that appear are complicated and confusing to one who is not aware of the relations just described. Sometimes it is hard to see why we have a gain when the chart shows we should have had a small loss; we may have a loss when a gain was expected, or the amounts expected and reported may be different because of these factors.[6]

The difficulty has found its way into textbook discussions, and there are suggestions as to how it may be dealt with. One of these suggestions is to use a computation that assumes (what actually may not be so) *no* change in inventory; another is to assume "that the percentage inventory change is constant all up

[5] These reasons include (1) variation in activity level from the assumed normal, (2) seasonal variation in costs affected by weather or habit-patterns, (3) erratic incidence of certain costs such as repairs, whose relation to activity levels may be undetermined, (4) departures from budget forecasts of the indirect costs used to set normal cost-allocation rates, and (5) inaccurate or inadequate policing of cost rates used in the system.

[6] See "Some Observations on the Break-even Chart," A. W. Patrick, *Accounting Review*, October 1958. Professor Patrick says, on p. 578, "The assumptions [of the break-even chart] are not necessarily valid, and when they are extended to recognize that (1) at times current production may exceed sales out of that production and (2) only the effective portion of fixed costs are assigned to product, *the* break-even point is found to be only one point among many."

and down the volume scale. This approach requires the adjustment of total fixed costs for fixed costs added to or deducted from inventory."[7]

A Formula to Bridge the Gap

All these situations suggest that the problems in this area need some kind of resolution, that there ought to be a "general" formula to take into account the complications we have described. Let us try to see if we can develop this.

The basic pattern for computing the break-even point in product units is

$$\text{Break-even volume (units)} = \frac{\text{Fixed cost}}{\text{Unit selling price—Unit variable cost}}$$

that is, the volume required to cover total costs is determined by dividing the unit contribution margin into total fixed cost. This relationship holds over the entire relevant range if (a) there is no fixed cost carried into inventories and (b) there is neither under- nor over-absorbed fixed cost. To establish a more general formula for break-even, these factors could be added to the formula given above. This, if we assume no initial inventories, would give us:

$$\text{Break-even volume} = \frac{\text{Total fixed cost—Unabsorbed fixed cost—Inventoried fixed cost}}{\text{Unit contribution margin}}$$

which could be written:

$$\beta = \frac{\Sigma\Phi - \Psi - \Omega}{\gamma}$$

$\Sigma\Phi$ is the total fixed cost incurred not only in manufacturing but in sales, administration and other organizational units. Ψ is the amount of fixed cost *not* absorbed by cost allocation. It could be the idle capacity variance shown in some standard cost systems, or it could include budget variance. The way it is treated in this formula is based on the idea that unabsorbed fixed cost is an "interim" carry-over, representing a deferred charge to future operations. The contribution margin, γ, is the difference between the unit sales price and the total unit-variable cost of manufacturing, selling, administration or other divisions.[8] The amount of inventoried fixed cost is a *subtraction* from the total fixed cost, because this amount is not charged against current income but is carried forward as a deferred charge to future operations; mathematically, it is the same kind of thing as "under-absorbed cost."

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[7] *Budgeting*, Glenn A. Welsch, Prentice-Hall, 1957, p. 272.

[8] The reader may wish to note the assumptions of (1) linearity of cost behavior and (2) the definition of "unit" as representing some comparable or homogeneous item, viewed over the whole field of enterprise operation. Whether units, volume, or variability can be defined in entirely homogeneous terms is a complex issue, the discussion of which lies outside the scope of this paper.

Complicating this situation by the addition of initial balances (deferred from an earlier period) makes the factors adjusting the total fixed cost incurred a bit more abstruse. It becomes necessary to recognize them as net changes rather than absolute amounts. If the closing inventory is less than the initial one, the inventory reduction becomes an addition to the fixed cost of the period, and this raises the break-even point. But the reduction must be a reduction of fixed cost, not of physical units or cost totals. Thus, if cost rates (or efficiency) have changed, it is possible to get mixed effects, depending on the amounts and items involved.

Under- or over-absorbed costs have exactly the same effect. Although these typically appear only in interim calculations, this very fact makes them more important, since interim fluctuations are understandably wider than annual totals, if only because of seasonal forces. However, for these interim computations, the net change in under- or over-absorption (in dollars) will affect the break-even point in the same way as inventoried fixed costs. Supposing there is under-absorbed fixed cost from operating at lower than the normal level at which fixed cost absorption rates were set, this deferred charge reduces the fixed cost element in the formula, lowering the break-even volume. An over-absorption (from higher than normal volume levels) would raise the break-even volume by adding to the fixed cost actually incurred ($\Sigma\Phi$) the credit carried forward to offset expected lower volume under absorptions implied in the use of a normal cost rate. The net change in an interim calculation might be in either direction.[9]

Allowing for these refinements, we may now re-state our break-even formula as follows:

$$\beta = \frac{\Sigma\Phi - \Delta\Psi - \Delta\Omega}{\gamma}$$

Our attempt to reconcile conventional income concepts with cost-volume-price relationships now involves computing various balance-sheet changes in order to allow for carry-overs from one interim period to another. It should also be pointed out that under- or over-absorption of fixed cost may result from various conditions besides abnormal production volume. Expenditures in excess of budget allowances, seasonal or erratically timed costs (such as equipment repairs) may produce under-absorptions. If such items were allowed for in the fixed cost

[9] The reader may be tempted here to conclude that fixed costs are causing our troubles because we use "normal" rates and create over- and under-absorbed balances. He should, perhaps, be reminded that fixed costs are never in any real sense "per unit" costs. The only way we can make them so is to divide by some unit-volume; unless this volume is a normal or a typical one, the resulting unit cost is capricious, arbitrary and probably meaningless. Hence, if we must assign fixed costs to inventory, they must be normal fixed costs and the structure we describe is inescapable.

allocation rates (as they would be if they were predictable) the result would be to show offsetting over-absorptions in other periods. But factors such as these necessarily affect the flow of costs into product-charges, if income is computed conventionally with fixed costs capitalized in inventories.

Other Difficulties

A further complication arises in connection with variable indirect costs; for these, too, may be under- or over-absorbed in an interim computation. Even though these costs are assumed to be linearly related to volume,[10] there is always the possibility that seasonal factors, departures from budget allowances, price shifts and other things may give rise to under- or over-absorptions. These variations are, however, somewhat different from those associated with fixed costs.

The contribution margin has been calculated by the use of normal variable costs. If there is additional variable cost not absorbed into the normal allocation, two things could be done. We might change the unit-cost used to establish the contribution margin, or we could treat the under-absorbed variable cost as an "inventoried" item. The first of these procedures typically is unsatisfactory, especially if the variance is a seasonal or timing factor that will level out at the end of the year. If we consider the unabsorbed variable cost as an "inventory" or deferred charge, the interim break-even computation is unaffected by the under- or over-absorption of variable cost.

At the end of a year, however, the under- or over-absorbed amounts are more troublesome. It is possible to "correct" the indirect cost allocations by writing off the net under- or over-absorptions into product costs via supplementary rates or prorations. These will have various effects upon income, and these effects are too complex to follow through here. However, unless the under- or over-absorbed balances are quite large, they are often written off as profit and loss charges, without proration over inventories and cost of goods sold.

The write-off of under- or over-absorbed fixed costs simply removes Ψ from the formula as given, since this amount is thus carried into expense. The inventory effect is unchanged by a direct write-off, although it would have been altered by a proration.

The presence of under- or over-absorbed variable costs at the end of a year has a different effect. Although these could be ignored in an interim statement, they must be recognized in the formula for a year-end computation. The failure

[10] This assumption is the basis for much criticism of break-even calculations and cost accounting generally. See Dean, *loc. cit.*, for a discussion of this. But statistical evidence suggests that there is some reason for accepting this assumption. *Statistical Cost Analysis*, J. Johnston, McGraw-Hill, New York, 1960, pp. 136-194; "On the Economics of Break-even," Douglas Vickers, *Accounting Review*, July 1960.

of normal-variable cost allocations to absorb the variable indirect costs incurred may be the basis for correcting the contribution margin, as suggested earlier. But if these under- or over-absorbed balances result from a typical, unusual or non-"normal" factors, it may be doubtful whether the unit-cost computation should be revised. In such a case, the balances are simply written off to profit and loss. Then, the under-absorbed "variable" costs are an added factor in the break-even analysis; the fact that they arise as deviations from the normal variable cost pattern makes them difficult to interpret. Luckily, the amounts are usually small.

However, these under- or over-absorbed variable costs are income determinants if they are written off to profit and loss (or even if they are prorated) and they would therefore affect the level at which a zero profit would be expected. There is no easy way to deal with these variations. Their treatment is debatable, unless we wish to make further assumptions and adjustments.

Reconcilable — But Real Differences

This paper has shown how and why the attempt to generalize a formula may result in more rather than less complication. Perhaps the general solution that is hoped for is neither simple nor general in the final analysis. What the search for the general formula teaches us is what we perhaps should have known in the first place; "income" is a computation that is affected by those things we wish to take into account. The attempt to relate break-even computations to the conventional notions of income merely shows that, somehow, the figures can be reconciled—if not easily, then with more or less trouble. However, the differences among "direct-cost income," "normal cost income," "actual average cost income" and other variants of the income concept are real differences. They result from different calculations aimed at differently conceived objectives; to reconcile them does not make them any less different. The accountant who recognizes this has gone a long way toward understanding his task, which is to fit his figures to their purposes. It is high time that we look at some of our conventional and unconventional notions to determine whether or not those purposes are clear!

Fixing Responsibility through Profit and Loss Analysis

by GERALD R. CROWNINGSHIELD and GEORGE L. BATTISTA

PROFITS do not just happen; profits come from performances that have been carefully planned and carried out according to plan. If the performance is below the expected, something must have caused it and somebody is responsible. Helping to detect the cause and point out the responsibility is an obligation of the accountant. It is his duty to wave the red flag that warns of impending danger. Ways in which this can be done through an extensive analysis of the income statement are the subject of this paper.

We shall assume that certain prerequisites to profitable operations have been met; that reasonably tight standards have been set, that these standards have been based upon the findings of engineering and price studies and that the standards represent what can be described as good performances. It will be assumed that a chart of accounts has been constructed with more attention paid to proper cost distribution for purposes of fixing responsibilities than to the simplification of recording and auditing. It will be assumed that responsibility for every cost rests with some individual and that this person has been delegated authority to control that is commensurate with the responsibility. Finally, it will be presumed that all costs have been analyzed as to their fixed and variable components and classified accordingly, which implies that semivariable costs have been further subdivided into the portion that remains constant and the portion that tends to vary. Any other assumptions would make an analysis extremely difficult, if not impossible. Unless costs have been classified according to behavior patterns, there is no possibility of determining either attainable profits or cost divergencies, and if responsibility for cost incurrence cannot be clearly fixed, if there are cross lines of authority, what can one expect but the practice of "passing the buck"?

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Percentage Comparisons May Be Misleading

A common method of analysis uses percentage comparisons. The procedure is simple, but is fraught with danger and, unless it is applied with care, it can be misleading as often as informative. Percentages have significance only if the base remains stable and provides comparable data. Suppose, for example, that during the year 19A a company sold 10,000 units of its product at $1.00 per unit and recorded traveling expenses of $1,300; during 19B, this company sold 9,000 units of product at $1.20 per unit and incurred traveling expenses of $1,260. If traveling expenses are expressed as percentages of sales, there seems to be an improvement when the two years are compared:

	19A		*19B*	
Sales revenue	$10,000	100.0%	$10,800	100.0%
Traveling expenses	1,300	13.0%	1,260	11.7%

Although it is true that traveling expenses took a smaller part of the 19B sales dollar, it is not true that there was a reduction in traveling expenses. To the contrary, when traveling expenses are expressed as unit costs of quantities sold, an increase is revealed:

	19A	*19B*
Traveling expenses	$ 1,300	$1,260
Units sold	10,000	9,000
Expenses per unit	$.13	$.14

A further illustration is provided by the following comparative statements of gross profit margins for two periods:

	Period 1	*Period 2*	*Percent of change*
Sales revenue	$100,000	$104,500	+ 4.5 %
Cost of sales	60,000	58,800	— 2.0 %
Gross margin	$ 40,000	$ 45,700	14.25%
Operating expenses	10,000	9,700	— 3.0 %
Net income	$ 30,000	$ 36,000	20.0 %

A cursory glance would indicate that the changes were favorable. Sales volume appears to be up and costs and expenses appear to be down. Net income has increased but has it increased as it might be expected to? Actually, it may be that sales volume (quantity) is down and unit costs are up. Assume, for example, that selling prices were 10 percent higher during Period 2. Had the same number

of units been sold at the new selling price, the sales revenue in Period 2 would have been $110,000. Since the actual sales were $104,500, the sales volume of Period 2 was only 95 percent ($104,500 ÷ $110,000) of the sales volume of Period 1. If unit costs of sales had remained the same, the cost of sales of Period 2 would have been only $57,000 (95% of $60,000). Likewise, if operating expenses per unit had remained the same, the expenses of Period 2 would have been only $9,500 (95% of $10,000). Actually, since unit costs and expenses went up, the over-all position is not favorable. As with the previous example, percentages failed to reflect price changes. It is quite apparent that something more than percentages must be developed.

Changes in profits originate from two sources: (1) changes in revenue and (2) changes in costs. If a single product is being sold, each of these two sources of change is affected by two factors: (1) price and (2) volume. If more than one product is sold, profits are further influenced by a third factor, the sales mix, since not all products carry the same profit margins. Usually, the net change is the result of an interplay of the factors, some favorable and some unfavorable. The changes in sales price and mix cause differences in revenue. The change in mix brings changed costs into play. Changes in physical volume of production associated with price or mix changes or merely with inventory policy, cause changes in unit cost by reason of the existence of fixed cost. Only a comprehensive analysis can show the effect of all the forces.

If all costs were controllable with physical volume of production, the total cost to make and sell would fluctuate directly with volume and unit costs would stay constant. The necessity of maintaining a fixed amount of capacity on a standby basis, utilized or not, prevents such a situation from existing and leaves some portion, in many instances the larger part, of the costs nonvariable in nature. With the total cost remaining the same and the number of units fluctuating, a change in volume must bring a change in cost that bears an inverse relationship to volume. This will be true not only of manufacturing costs but also of selling and administration expenses. Thus, as the volume of production and sales climbs upward, nonvariable costs per unit drop; as the volume goes down, nonvariable unit costs go up.

Volume alone, then, exerts a double-barreled influence on profits; it affects both the revenue and the unit costs. As the number of units produced and sold decreases, sales revenue falls and unit costs climb. With both forces unfavorable, it is not long before cost and revenue meet and losses begin. Analysis is not easy and is complicated by the inevitable change of mix from period to period.

Variance Analysis Related to Price and Volume Changes

An adequate analysis of profit and loss must first isolate the effects of changes in volume, price, and product mix. (Our first examples will omit the mix factor, which will then be explicitly introduced into our explanations.) If the analysis is to be used in a program of cost reduction and control, responsibility for every change must be traced to individuals. In many instances, responsibility falls in odd places. The sales manager, for example, may be given credit for a decrease in the cost of sales. Take the case of the company that showed the following gross margins over a two-year period:

	19A		*19B*	
Sales revenue	$960,000	100%	$1,380,000	100%
Cost of sales	672,000	70%	648,000	47%
Gross margin	$288,000	30%	$ 732,000	53%

At the end of 19A, management decided that an increase in the selling price was desirable. Accordingly, an increase of 15 percent was put into effect on January 1, 19B. At the same time, a new plant manager was hired who devoted much of his time during the year to reducing plant costs. A dispute which will serve our purpose here has now arisen between the new plant manager and the vice president in charge of sales. Both men admit that a large part of the increase in gross margin was due to the increase in the selling price. The plant manager insists that the savings in factory costs were greater in amount than the increase in gross profits due to the increased volume of sales, citing a drop in cost of sales from 70 percent in 19A to 47 percent in 19B. The vice president is equally insistent that the increase in sales volume made the greater contribution.

This dispute cannot be settled by looking at the drop in the cost of sales. To be considered are the following facts:

1. Since the selling price of the product increased, the percentage of cost to selling price would have to drop, even though costs had remained constant. As a matter of fact, it would be possible for the percentage to drop even though the cost increased. A lower percentage is not proof that costs were lower, only that the relation to sales price decreased.

2. If the number of units sold increased, the nonvariable cost per unit would have to decrease. But again, the lower unit costs do not prove that the production manager was able to reduce production costs, only that fixed costs were spread over more units.

Before a decision can be reached, an analysis of the change in gross margin in terms of price changes and volume changes must be made. The following computations will provide a start:

	Column 1 19A volume at 19A price	*Column 2 19B volume at 19A price*	*Column 3 19B volume at 19B price*	*Change in gross margin due to change in volume (a)*	*price (b)*
Sales revenue	$960,000	$1,200,000(c)	$1,380,000	+$240,000	+$180,000
Cost of sales	672,000	840,000(d)	648,000	− 168,000	+ 192,000
Gross margin	$288,000	$ 360,000	$ 732,000	+$ 72,000	+$372,000

(a) Column 2 minus Column 1

(b) Column 3 minus Column 2

(c) $$\frac{\text{19B volume at 19B price}}{1 + \%\text{ of change in price}} = \frac{\$1,380,000}{1 + .15} = \$1,200,000$$

(d) 19B volume at 19A price × 19A cost percentage = .70 × $1,200,000 = $840,000

This analysis deflates sales and cost of sales for price changes and gives us the following data:

1. The volume of sales increased by 25 percent ($240,000 ÷ $960,000).

2. The 15-percent increase in selling price added $180,000 to the gross margin.

3. The increased volume would have brought an increase of $168,000 in the cost of sales had no cost changes taken place.

4. Because reductions were made in unit costs, $192,000 was added to the gross margin.

The change in gross margin attributable to change in unit costs makes it appear, on the first examination, that the plant manager was correct in his contention that the savings in factory costs of $192,000 contributed more to the increase in gross margin than did the increase in sales volume that contributed only $72,000. However, this would be true only if all costs were variable. To the extent that fixed costs are involved, this conclusion is invalid. Assuming that the cost of sales were made up of the following nonvariable and variable components, the conclusions would be quite different:

	19A
Nonvariable costs	960,000 units @ $.42 = $403,200
Variable costs	960,000 units @ $.28 = $268,800
	960,000 units @ $.70 = $672,000

	19B
Nonvariable costs	1,200,000 units @ $.336 = $403,200
Variable costs	1,200,000 units @ $.204 = $244,800
	1,200,000 units @ $.540 = $648,000

Now the cost reduction of $192,000 can be broken up into two parts:

	Per unit reduction	*Number of units*	*Total*
Nonvariable costs	$.084	1,200,000	$100,800
Variable costs	.076	1,200,000	91,200
	$.160	1,200,000	$192,000

Since the plant manager effected no decrease in the expenditures for nonvariable costs, the increase in volume must be credited with a cost reduction of $100,800; the plant manager can claim credit for reducing expenditures by only $91,200. Now it can be determined that the increase in volume accounted for an increase of $172,800 in gross margin:

Attributable to additional volume —	
Increase in sales revenue	$240,000
Increase in cost of sales	168,000
Increase in gross margin from additional volume	$ 72,000
Decrease in unit nonvariable manufacturing costs	$100,800
Total increase in gross margin	$172,800

This amount is far greater than the reduction of factory costs of $91,200 traceable to the plant manager.

Analysis of Selling and Administrative Expenses Fluctuation

The preceding illustration did not consider selling and administrative expenses, an area which is too often neglected in profit and loss analysis. In too many instances, analyses stop at the gross margin and use only the absolute amount of the increase or decrease in selling and administrative expenses to account for changes in net profit. Needless to say, these expenses should be as carefully scrutinized as are the items that enter into the cost of sales. Selling and administrative expenses behave in the same manner as indirect manufacturing costs. There are volume and spending factors involved in selling and administrative expenses, even though they are treated as period costs not associated with

the product. Fixing responsibility for variances in this area is as important as it is in the case of the cost of sales. The expression of such expenses merely as percentages of sales can be even more misleading than a cost-of-sales percentage of revenue, because there are likely to be more items of the fixed variety among selling and administrative expenses. A proper analysis of these expenses requires that they, too, be segregated into nonvariable and variable components.

Let us assume that a company made the following selling and administrative expense data available:

	19A			*19B*		
	Amount	*Units sold*	*Per unit*	*Amount*	*Units sold*	*Per unit*
Nonvariable expenses	$2,700	10,000	$.27	$2,700	9,000	$.30
Variable expenses	900	10,000	.09	990	9,000	.11
	$3,600	10,000	$.36	$3,690	9,000	$.41

An analysis might proceed as follows:

	19A volume at 19A price	*19B volume at 19A price*	*19B volume at 19B price*	*Change in net profit due to*	
				volume	*price*
Nonvariable expenses	$2,700	$2,430	$2,700	+$270	−$270
Variable expenses	900	810	990	+ 90	− 180
	$3,600	$3,240	$3,690	+$360	−$450

This analysis says that, if unit selling and administrative expenses had remained the same, the 10-percent decrease in volume would have brought about a reduction in profit of $360. However, unit expenses did not remain the same; there was a sales price increase of $450. Part of the expense increase ($180) was due to additional spending; the rest ($270) was brought about by decreased physical volume of sales which caused an increase of the per unit nonvariable expenses. With the spending factor separated from the volume factor, steps to fix responsibility can be taken.

Changes in Product Mix

Our discussion up to this point has not considered change in product mix. In fact, we have acted as if only one product is being produced and sold. If more than one product is involved, the volume change must be broken down into two parts:

1. That part which is the result of a change in the number of units sold, hereafter called the quantity change.

2. That part which is the result of a change in the sales mix, hereafter called the variety change.

As an illustration, let us consider the following comparative statements of gross margin prepared for a company:

	19A		*19B*	
Sales revenue	$400,000	100.0%	$350,000	100.0%
Cost of sales	210,000	52.5%	190,000	54.3%
Gross margin	$190,000	47.5%	160,000	45.7%

In the interests of simplicity, we shall assume that there were no changes in selling prices or cost prices and that the change in gross margin of $30,000 is attributable entirely to volume. The problem is to determine how much is traceable to a change in the number of units sold and how much is attributable to a change in the variety of products sold.

Had the sales variety in 19B been the same as in 19A, the gross margin would have been 47.5 percent of sales revenue; a drop in sales volume of $50,000 would have meant a decrease in margin of $23,750:

$$\text{Quantity change} = \$50{,}000 \times .475 = \$23{,}750.$$

Because of a change in the sales mix from more profitable to less profitable products, there was a further reduction in margin of $6,250:

Gross margin on 19B volume at 19A percentage —	
$350,000 × .475	$166,250
Gross margin reported for 19B	160,000
Variety change	$ 6,250

The above analysis points out how deceiving comparative statements can be. In this case, the plant manager might very well be blamed for higher costs when further study would reveal that the sales organization is at fault for not pushing the more profitable products.

Comparison with Attainable Results — Break-Even Analysis

Effective cost control is a continuous operation that should be applied with the same vigor when sales revenue is up as when sales revenue is down. Too often cost control is lenient when revenue is easy to come by and it is only during periods of economic recession that full pressure for cost reduction is exerted.

High returns during a period of prosperity cannot be taken as indications of good cost management. The question is not "Have we made a fair return on the high sales volume of this period?" but rather "How does the profit of the period compare with the return that might have been there had sales volume been down and costs more rigidly controlled?" Here the break-even analysis comes into the picture.

Any type of analysis which does not give consideration to what the results should have been is faulty. For instance, one company that would have been satisfied with a net profit of 14 percent and was very happy with 15.5 percent, found, through break-even analysis, that profits based on the volume attained should have been 25 percent. Individuals had been commended when they should have been reprimanded.

To make this point clear, let us assume that an accountant prepared the following comparative income statements:

	19A	*19B*	*Increase*
Sales revenue	$100,000	$120,000	20%
Variable costs	$ 20,000	$ 25,200	
Nonvariable costs	70,000	72,000	
Total costs	$ 90,000	$ 97,200	8%
Net income	$ 10,000	$ 22,800	128%

It is known that the selling prices of the company's products did not change in 19B. It is also known that the prices paid for input factors did not change during 19B and that the increased volume of sales did not require the addition of any new facilities that might add to the nonvariable costs.

The comparative income statements paint a rather rosy picture. Knowing that all changes were caused by a volume increase, gross profit analysis of the type discussed in foregoing sections would indicate that the increase in gross profit of $12,800 was caused by increased sales volume of $20,000 with a corresponding increase in cost of sales of $7,200, also due to increased sales volume. However, an income statement for 19B based upon the sales volume of 19B and the costs of 19A would appear as follows:

Sales revenue		$120,000
Variable costs	$24,000	
Nonvariable costs	70,000	94,000
Net income		$ 26,000

Since input prices did not change, the nonvariable costs should have remained constant and variable costs should have been 20 percent of sales.

The break-even point based on 19A can be computed as follows:

$$\text{Break-even point} = \frac{\text{Nonvariable costs (\$70,000)}}{1 - \dfrac{\text{Variable costs (\$20,000)}}{\text{Sales revenue (\$100,000)}}} = \$87{,}500$$

Break-even analysis based on the performance of 19A would have permitted a projection of the profit for the increased sales volume. It would have permitted management to expect an additional profit of $16,000 on the increase in sales revenue of $20,000. Here, again, is a situation where the wrong type of analysis fails to fix responsibility properly.

Objective: Responsibility Assignment — and at All Levels

Up to this point, consideration has been given only to the fixing of responsibility for current year performance based upon the prior year results. This was done primarily for the purpose of showing the weaknesses of the comparative, percentage-type of income statements for purposes of drawing conclusions. An analysis, if it is going to be of any value, must be based upon a valid standard of measurement. A comparison of the current year with a prior year is valueless if the prior year performance was not typical or normal. If there were inefficiencies in last year's figures, certainly a responsible individual should not be rewarded for improving the current year performance when in reality he has merely achieved what he should have been doing in the first place.

The foregoing type of analyses are faulty also in another respect; cost changes are analyzed only from the point of view of total price and total sales volume. Consequently, responsibility is fixed on top level management only. If responsibility is to be "pinpointed," a predetermined cost for each of the cost factors, i.e., materials, labor and overhead, must be established and variances from this standard or budget must be analyzed by causes. This would reach all levels of management and would provide the means with which to identify danger areas as soon as they develop. The more detailed the predetermined costs are, the more precise will be the fixing of responsibility. How this can be done through profit and loss analysis is illustrated by Exhibits 1, 2 and 3.

Illustrative Analyses

During the last quarter of 19A, the controller prepared a budgeted income

Budgeted Net Income
Year Ending December 31, 19B

	Total for 10,000 units	Per unit
Sales revenue	$10,000	$1.000
Cost of sales:		
Material -- 10,000 pieces @ $.135	$ 1,350	$ .135
Labor -- 1,000 hours @ $1.35	1,350	.135
Indirect manufacturing costs:		
Nonvariable	1,800	.180
Variable	1,500	.150
	$ 6,000	$ .600
Gross margin	$ 4,000	$ .400
Selling and administrative expenses:		
Nonvariable	$ 2,700	$ .270
Variable	900	.090
	$ 3,600	$ .360
Net income	$ 400	$ .040

EXHIBIT I

statement for the year 19B that is reproduced in Exhibit 1. The actual results of the year's operations are shown in the company's income statement reproduced in Exhibit 2. When the budget was being prepared, the sales manager had expected to sell 10,000 units of product at $1.00 per unit. Before the year began, it was decided to increase the selling price to $1.20 per unit. Sales fell below expectations and only 9,000 units were sold. The president of the company has asked for a complete accounting of the drop in net income.

Two facts were immediately apparent. The selling price was increased by 20 cents per unit and sales volume dropped off 10 percent. Through these two facts we can account for two changes that took place in net income:

1. When the selling price was increased by 20 cents per unit on 9,000 units sold, the net income was increased $1,800 over the expected figure.

2. When the volume dropped off 10 percent, the company lost the revenue and eliminated the cost of 1,000 units. Had the selling price and costs and expenses remained as budgeted, this would have resulted in a loss of net income of $40 (1,000 units at $.04).

Had unit costs been as budgeted, the 10-percent reduction in volume would have brought a $600 reduction in the cost of sales:

Budgeted volume at budgeted cost—10,000 units @ $.60	$6,000
Actual volume at budgeted cost—9,000 units @ $.60	5,400
Decrease in cost of sales from volume change 1,000 units @ $.60	$ 600

However, the cost of sales recorded exceeded the budget by $750. This means that costs increased by $1,350 during the year. To be of any value to management this increase must be broken down. Unit costs for the year were as follows:

	Per unit costs		
	Budgeted	*Actual*	*Net change*
Material	$.135	$.180	$.045
Labor	.135	.190	.055
Nonvariable indirect costs	.180	.200	.020
Variable indirect costs	.150	.180	.030
	$.600	$.750	$.150

Income Statement
Year Ended December 31, 19B

	Total for 9,000 units	Per unit
Sales revenue	$10,800	$1.20
Cost of sales:		
Material -- 10,800 pieces @ $.15	$ 1,620	$ .18
Labor -- 1,425 hours @ $1.20	1,710	.19
Indirect manufacturing costs:		
Nonvariable	1,800	.20
Variable	1,620	.18
	$ 6,750	$ .75
Gross margin	$ 4,050	$ .45
Selling and administrative expenses:		
Nonvariable	$ 2,700	$ .30
Variable	990	.11
	$ 3,690	$ .41
Net income	$ 360	$ .04

EXHIBIT 2

By multiplying the increase in unit costs by the number of units produced during the year, we can divide the $1,350 cost increase into its component parts:

Material—9,000 units @ $.045	$ 405
Labor—9,000 units @ $.055	495
Indirect manufacturing costs:	
Nonvariable—9,000 units @ $.02	180
Variable—9,000 units at $.03	270
	$1,350

Had unit selling and administrative expenses remained as budgeted, the 10-percent decrease in volume would have brought a reduction of $360:

Budgeted volume at budgeted cost—10,000 units @ $.36	$3,600
Actual volume at budgeted cost—9,000 units @ $.36	3,240
Decrease from volume change—1,000 units @ $.36	$ 360

Selling and administrative expenses did not drop, however; in these categories there was an increase of $90 over the budgeted amount. There were, then, price increases of $450. Unit selling and administrative costs for the year were as follows:

	Per unit costs		
	Budgeted	*Actual*	*Net change*
Nonvariable	$.27	$.30	$.03
Variable	.09	.11	.02
	$.36	$.41	$.05

By multiplying the increases in unit costs by the number of units sold during the year, we can break down the increase of $450 as follows:

Nonvariable expenses—9,000 units @ .03	$270
Variable expenses—9,000 units @ $.02	180
	$450

With the data accumulated so far, we can set up the following analysis:

	Changes in net income	
	Decreases	*Increases*
Increase in selling price of product		$1,800
Loss of net income from reduction in volume of sales	$ 40	
Increase in unit costs to manufacture:		

Material	$405		
Labor	495		
Indirect manufacturing costs:			
Nonvariable	180		
Variable	270	1,350	
Increases in unit selling and administrative expenses:			
Nonvariable	$270		
Variable	180	450	
		$1,840	$1,800
Net decrease			40
		$1,840	$1,840

Informative though it may be, this analysis is incomplete since it fails to provide sufficient information for fixing responsibility for changes in unit costs and expenses. In the case of material, for example, it does not tell which part of the cost change is attributable to usage and which to price. If individuals are to be held accountable, the figures must be broken down further to separate quantity and price factors. This is accomplished by calculating variances.

The increase in the material cost can be split up into a usage variance and a price variance, calculated as follows:

Material usage variance:		
Actual quantity of material used	10,800 pieces	
Budgeted quantity for 9,000 units	9,000 pieces	
Excess quantity	1,800 pieces	
Price at budgeted allowance of $.135 per piece		$243
Material price variance:		
Actual price per piece	$.150	
Budgeted price per piece	.135	
Excess over budgeted allowance	$.015	
Excess on 10,800 pieces issued		$162
Total material variance		$405

In similar fashion, the increase in labor cost can be divided into an efficiency variance and a rate variance:

Labor efficiency variance:	
Actual hours used	1,425

Budgeted hours allowed for 9,000 units	900	
Excess hours	525	
Priced at budgeted allowance of $1.35 per hour		$708.75
Labor rate variance:		
Budgeted rate per hour	$1.35	
Actual rate per hour	1.20	
Savings per hour	$ .15	
Savings on 1,425 hours		(213.75)
Total labor variance		$495.00

The increase in the unit nonvariable costs is the result of the drop in the volume of production. The budget anticipated that $1,800 of nonvariable costs would be spread over 10,000 units; actually, the $1,800 of budgeted costs had to be absorbed by 9,000 units at an increase of 2 cents per unit over the budget, a total of $180. This could be expressed also as an unfavorable volume variance, or idle capacity cost (idle when compared with budget):

	Units	*Percent*	
Budgeted capacity	10,000	100	
Utilized capacity	9,000	90	
Capacity not utilized	1,000	10	
Unfavorable volume variance:			
10 percent of budgeted nonvariable costs of $1,800			$180

The increase in the unit variable costs is the result of spending. Comparison of actual expenditures with budgeted allowances for the volume attained will give the amount:

Variable indirect costs recorded	$1,620
Variable indirect costs allowed—9,000 units × $.15	1,350
Unfavorable spending variance	$ 270

Changes in the unit selling and administrative expenses lend themselves to the same kind of analysis as the indirect manufacturing costs. The increase in the unit nonvariable costs is traceable to the drop in the number of units sold; the increase in unit variable expenses is traceable to spending. Unfavorable volume and spending variances can be developed:

Volume variance:

	Units	*Percent*	
Budgeted sales volume	10,000	100	
Actual sales volume	9,000	90	
Sales capacity budgeted but not attained	1,000	10	
Unfavorable volume variance:			
10 percent of budgeted nonvariable expenses of $2,700			$270
Spending variance:			
Variable selling and administrative expenses			$990
Variable selling and administrative expenses allowed: 9,000 units × $.09			810
Unfavorable variance			$180

Now the data can be assembled as a detailed analysis accounting for the change in net income as has been done in Exhibit 3. One comment is necessary. Here, spending variances are shown as totals; in practice, each individual cost and expense would be analyzed.

The final step is to find reasons for the variances, and then to seek out the responsible individuals. In the case illustrated, investigation revealed that most of the material usage variance was caused by the use of material which was not up to specification. It was further discovered that the purchase of inferior materials was brought about because of material shortages and that premium prices had to be paid for whatever materials could be obtained. This accounted also for most of the material price variance.

Investigation revealed further that a "walkout" of regular operators had necessitated the use of inexperienced workmen. This also affected the material usage variance unfavorably but it brought about the favorable labor rate variance.

The decrease in volume of sales was the cause for the unfavorable volume variances. This was traced in part to the sales department, because they were unable to sell all that had been anticipated, and, in part, to the production department which could not produce enough to meet the sales orders. It was discovered that the sales department could not sell the budgeted number of units because of an economic recession, and that the production department could not meet production requirements because of the strike of regular operators.

Each item of expense entering into the spending variances was analyzed, and the responsible individuals were held accountable.

Analysis of Change in Net Income
Year Ended December 31, 19B

	Budgeted	Actual	Net change Amount	Net change Percent
Sales volume in units	10,000	9,000	-1,000	-10.00
Sales revenue	$10,000	$10,800	+$ 800	+ 8.00
Cost of sales	6,000	6,750	+ 750	+12.50
Gross margin	$ 4,000	$ 4,050	+$ 50	+ 1.25
Selling and administrative expense	3,600	3,690	+ 90	+ 2.50
Net income	$ 400	$ 360	-$ 40	-10.00

Decrease in net income accounted for as follows:

Increases in net income:		
Increase in selling price of product	$1,800.00	
Favorable labor rate variance	213.75	$2,013.75
Decreases in net income:		
Loss of net income from reduction in volume of sales	$ 40.00	
Unfavorable material usage variance	243.00	
Unfavorable material price variance	162.00	
Unfavorable labor efficiency variance	708.75	
Unfavorable indirect manufacturing costs variances:		
Volume	180.00	
Spending	270.00	
Unfavorable selling and administrative expenses variances:		
Volume	270.00	
Spending	180.00	2,053.75
Net decrease in net income		$ 40.00

EXHIBIT 3

Information and Analyses

If management is to attain its objective of earning profits for its stockholders, it is necessary that it be properly and currently informed of what is happening. The analyses furnished to management should be comprehensive enough to provide the information necessary to take corrective action. They should be able to pinpoint responsibility in order to facilitate control.

Analyses based on wrong assumptions can lead to disaster. Since incorrect analyses may result from inadequate information, it is incumbent upon the accountant to keep the accounts in such a manner as to provide accurate and comprehensive data. It is also the duty of the accountant to be well versed in the proper techniques of analysis.

Self-Processed Pay Checks

by ROBERT D. RHOADS*

MOST ACCOUNTANTS will agree that the pay-roll procedure is one of the most time-consuming phases of industrial accounting. With hundreds of employees on a pay roll, time spent in gathering data and developing this data through the payment stage can be staggering. The purpose of this letter is to point out a remedy which can effectively reduce one large step in the pay-roll procedure to practically nothing.

The company employing this technique gathers the pay-roll data in its usual fashion and refines it into a pay-roll journal, listing each employee and the customary pay-stub information. At this point, instead of having the pay checks completed, the company sends a copy of the pay-roll journal to the bank along with a check for the total amount of the net pay roll. The bank then credits a checking account for each employee on the list with his share of the pay roll. The employee goes for his wages direct to the designated bank. He may use this checking account as his own and write checks in the customary manner or, if he prefers not to do this, he can write a countercheck for the total amount and withdraw it. He may even let the bank teller write the countercheck for him and put only his signature on it.

Among advantages in employing this technique are the following:

1. The company is relieved of a check-writing task which may take hours, depending on the number of employees.
2. No enveloping or handling is necessary on the part of the company.
3. It eliminates the tedious task of reconciling the pay-roll account which involves the job of listing outstanding checks, examining endorsements and perforation dates, watching for alterations, accounting for errors, etc.
4. It is no longer necessary for the company to urge certain employees to cash their pay checks in order to delete these checks from the outstanding list.
5. The employee no longer gets his hands on the pay check, eliminating the dangers of alteration, theft, loss or other mishaps possible in the handling of the check.
6. Neither the company nor the bank have to bother with stop payment procedures that were necessary in the case of theft and loss under the former technique.

Besides those advantages to the company, the bank, also, finds this type of business highly desirable, having thus added a company pay-roll account and numerous checking accounts to its list of depositors.

As the public becomes more familiar with the use of checking accounts, this technique will grow in acceptance. The first step for a company in this direction may be with its salaried people who generally understand the facets of banking more readily.

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Standard Costing Needs Better Variances

by DAVID SOLOMONS

THE YEAR 1961 marks an anniversary in the history of accounting, for it is just fifty years since the first fully integrated standard cost system was installed. It was in 1911 that G. Charter Harrison designed and installed what he described as "the first complete standard cost system on record as far as I know."

Several men before G. Charter Harrison had seen the potentialities of the use of standards as an aid to management, though their use of them was partial and fragmentary, whereas his was rounded and complete. This system has developed into an extraordinarily versatile tool; for it is perhaps the most impressive achievement of standard costing that it has gone such a long way toward providing, by means of a single integrated system, so many different kinds of cost data for so many different purposes. For the purposes of inventory valuation we can use product standard costs or, if variances from standard are too large to ignore, we can approximate product actual costs by prorating the variances over the products. If we are "direct costers," we have only to exclude fixed costs from these computations. For pricing purposes, similarly, we can use either full product standard costs or product direct standard costs, depending on whether we favor absorption costing or direct costing. For control purposes, we have costs allocated not to products but to responsibility centers and cost centers, with as elaborated an analysis of variances from standard as we think it is worth paying for. No one can say that standard costing is not versatile. Indeed, in its capacity for being "all things to all men" lies its great strength.

But we have a long way to go before standard costing can be regarded as having been perfected. If in this critique there seems to be an undue emphasis on some of its weaknesses while its virtues are taken for granted, it is not because those virtues are under-rated. Indeed, standard costing probably represents the greatest advance in accounting since the development of double-entry bookkeeping itself. Yet that does not mean, even after fifty years, that it has reached anything like its full growth.

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What Kind of Standards?

One difficulty which has beset standard costing from the earliest days is that of agreeing upon and defining the nature of the standards to be used; out of the discussion has come a large measure of agreement that the most useful type of standard is one which represents "attainable good performance." However, this question cannot be regarded as closed, and indeed Stedry's recent work[1] forces us to look at it afresh.

We have usually been content to ignore the effect of the standard on the level of performance and to assume that as the process of measuring physical quantities does not have any effect on what is being measured, so the level at which a standard is set has no effect on the level of achievement; or, alternatively, we have made the assumption that an unattainably high standard will be ignored by those who are expected to work to it and will therefore be ineffective. Stedry's experimental results cast doubt on these assumptions and suggest that setting a high standard, even if it is not attained, may significantly raise the level of performance above that achieved when standards are loose. Stedry's conclusions are not lightly to be accepted as applicable under normal working conditions. Indeed, there is room for scepticism about the relevance of his findings—based as they are on a short-term experiment on university students, even though carefully designed and executed—to the long-run behavior of people working for their living. As Stedry himself recognizes, a stimulus which is effective in the short run may not persist or may even "backfire" and have undesirable long-term effects. The important point is that a substantial amount of research is still required to establish the facts. As accountants we are apt to regard standards and budgets rather mechanically, without benefit of what the behavioral scientists can tell us or find out for us about their impact on people and on their aspirations.

Incidentally, the N.A.A.'s generally excellent *Re-Examination of Standard Costs*[2] perhaps itself needs re-examining on this point. "While it is sometimes said," it states, "that an unattainable tight standard provides an incentive to reduce costs, it seems that this use of the standard confuses the objectives of cost reduction and cost control. Cost reduction proceeds by finding ways to achieve a given result through improved design, better methods, new layouts, incentive plans, etc. Hence, cost reduction results in the establishment of new standards. On the other hand, cost control is a process of maintaining performance at as near existing standards as is possible." This surely makes the mistake which has just been discussed of ignoring the impact of standards on behavior.

[1] *Budget Control and Cost Behavior*, Andrew C. Stedry, Prentice Hall, 1960.

[2] Research Series No. 11, *N.A.(C.)A. Bulletin*, Section 3, February 1948.

We cannot wholly separate cost control and cost reduction even if we want to. The results we get are not just the result of "improved design, better methods, new layouts, incentive plans, etc." Human effort, both on the part of workers and managers, presumably still has its part to play. If the level of performance is itself a function of budget levels and standards, the methods we use to control costs will directly affect the level of costs we achieve. Cost control and cost reduction are inextricably mixed up with each other, and to realize this fact is not to "confuse" them, but to recognize a potentially important relationship.

What Kind of Variances?

Having raised some questions about the nature of standards, let me now raise a few questions about the nature of variances, for if there is to be any substance in the claim that standard costing makes possible "management by exception," the significance to be attached to variances from standard cost must be clear and unambiguous; variances which go by the same name must represent the same thing, and fundamentally different kinds of "exceptions" from normal must be reflected accordingly in our accounting statements. Of course, normal procedures already go quite a long way in this direction and we have to recognize that further refinements may cost more than they are worth. Yet there are some directions in which perhaps further refinement would be worth its modest cost for if a variance which masquerades as a substantially homogeneous quantity is really not so, or if a variance, because of the name given it, pretends to be one thing and is really another, then the money at present being spent on quantifying it is, at the best, being wasted and, at the worst, is causing management to be misled.

What Does Price Variance Mean?

Although a great deal has been written during the last twenty years about the impact of rising prices on financial accounting reporting and about its effect on the real burden of taxation, relatively little has been said about the disturbing effect it may have on accounting for managerial purposes. It may be argued, of course, that standard costing does all that needs to be done by separating the effect of inflation as a price variance. Certainly, to the extent that it does this, standard costing represents a considerable advance over conventional historical costing, which makes no attempt to distinguish between price and quantity effects. Nevertheless, I doubt whether such a simple distinction is good enough, for, on closer examination, a price variance will be seen to be anything but

homogeneous. In fact, it may turn out to be a mixture of at least five different things, namely:

1. The result of price fluctuations which have occurred since the standards were set.
2. The result of inefficient buying.
3. The result of substitutions differing from standard.
4. The result of inflationary pressures on price in general.
5. The effect on the buying price of purchasing in more or less than the budgeted quantities.

In the paragraphs following, the discussion will be confined to raw material prices. Much the same considerations apply, of course, to other resources which are purchased at fluctuating prices.

Ideally, we ought to keep the above five causes of variance between actual and standard prices separate from each other. Many costing installations do separate as a cost variance the effect of the substitution of one material for another or one quality for another. Little attempt has been made, on the other hand, to reflect the other distinctions referred to above—between the effect of price fluctuations and of inefficient buying, between fluctuations in relative prices and inflationary pressures on prices in general, and the incidence of quantity rebates.

The failure to make the first of these distinctions is easy enough to account for. The fact is that it is probably impossible to say whether a price variance has been caused by a movement of relative prices away from the standard or whether it was caused by inefficient buying.[3] Inefficient buying may mean many different things, some of them having nothing to do with price. Buying at a price different from standard certainly does not necessarily imply inefficiency; buying at a price higher than it need have been probably does. In any particular instance, it is impossible for anyone but the person responsible for a purchase to say whether the price was "higher that it need have been." Thus, it is impossible, as a matter of routine, to say whether an unfavorable price variance represents an uncontrollable price change or an avoidable inefficiency in purchasing. Conversely, a favorable price variance or the absence of an unfavorable price variance does not imply that the purchasing function has been carried out efficiently.

Inflation and the Price Variance

This means that the significance to be attached to a price variance is always

[3] Here, and throughout this paper, the discussion of variances is couched mostly in terms of *unfavorable* variances. The reader should have no difficulty in re-phrasing the discussion in terms of favorable variances.

subject to some doubt. Nevertheless, we could reduce the area of doubt somewhat if we did more than is commonly done to determine the fourth element of the price variance listed above—the effect of inflation (or deflation, of course) on prices and to carry this to a separate variance account. There is no need to go into detail here about the technique of stabilizing accounts during periods of inflation, since this has been described many times. What is called for, so far as it concerns standard costing, is simply the calculation of a "price-level price variance."[4] This can be done by comparing the actual cost of materials purchased during the period with the same figure adjusted to the price-level ruling at the beginning of the period.

Taking a period in which actual purchases amounted to $15,000, the wholesale price index at the beginning of the period had been 110 and the average index for the period was 112; then the price-level variance (unfavorable) in terms of average dollars of the period, would have been $\$15{,}000 \times \frac{112-110}{112}$ or $268. It will be noted that this figure has been calculated by reference to the materials purchased during the period, not by reference to the material consumed. The price-level variance makes much more sense this way (as do all price variances, in my opinion). It would be possible to calculate it by reference to the period's consumption, but this procedure would be both more complicated and less meaningful.

The Further Analysis of Price Variances

Before we leave the analysis of price variances, we had better face two other unsatisfactory aspects of standard costing which are of some theoretical interest. One of these is the failure to distinguish the fifth element of price variance which has been listed above, namely increments or decrements in price which are the result of purchasing larger or smaller quantities of material than budgeted. The other is the difficulty, perhaps the impossibility, of satisfactorily dividing the total difference between the actual and standard cost of materials into price effects (however analyzed) and the quantity effect in an uniquely correct and unambiguous manner.

The diagram shown on Exhibit 1 may enable us to consider both of these matters together. For simplicity, let us suppose that a single basic material is used, say pulp of some kind, and also, for simplicity, let us assume that there is no change in raw materials inventory during the period, i.e. that purchases

[4] It seems better to avoid the term "inflation price variance," since periods of inflation and deflation might one day again alternate with each other, and the term "price-level price variance" would cover both.

equal consumption. The lower curve OCB represents the budgeted cost of buying varying quantities of pulp. Because the price is expected to fall as the quantity bought increases, the curve rises at a diminishing rate.[5] The expected usage at standard is the quantity OQ, and through Q we draw the vertical SQ (for standard quantity). The actual quantity used exceeds the standard quantity, we will suppose, and is the quantity OQ′. Through Q′ we draw the vertical AQ (for actual quantity). We represent the standard price (the originally budgeted price) by the slope of the line OC drawn from the origin through C (the intersection of the budget curve with the vertical SQ) and extended on to D, where it cuts AQ. The budgeted cost for the actual quantity used is given by the point B, the intersection of the budget curve with the vertical AQ. The actual prices ruling during the period, which we will suppose turned out to be above what was expected for some reason unconnected with quantity rebates, are represented by the upper curve OEF, E and F being its points of intersection with SQ and AQ respectively. This curve will be of roughly the same shape as the budget curve, no doubt, but on our assumption that actual prices were above budgeted, it had to be drawn at a higher level.

We can now see that what would usually be regarded as the unfavorable price variance FD, the excess (in this case) of the actual quantity of purchases evaluated at the actual price (FQ′) over the actual quantity evaluated at the standard price (DQ′), is really made up of two elements. One of these is the excess of the actual quantity at the actual price (again FQ′) over the actual quantity at the budgeted price (BQ′). This excess is the amount FB and it represents, it may be argued, the true price variance—unfavorable in this case. The other part of what would usually be called the price variance is the difference between the actual quantity of purchases evaluated at the standard price and the actual quantity evaluated at the budgeted price. This is the favorable variance BD and it represents the saving which results from the lower prices obtained because of the greater-than-standard purchases. We can perhaps call it a quantity rebate variance, and it arises because the standard price is constant for all levels of quantity purchased, whereas budgeted prices are not. It is closely related to the capacity variance encountered when we analyze overhead variances, in that this also arises because the standard overhead rate, once set, is constant for all levels of capacity, with the result that standard cost varies directly with the level of activity whereas the budgeted cost, which we read off the flexible budget and which usually contains some fixed costs, does not.

We have here, then, another instance where standard costing presents as a

[5] It would no doubt be more realistic to represent the function by a series of line segments rather than a smooth curve; but, while not affecting the principle at all, this would be both less pleasing to look at and less tractable mathematically.

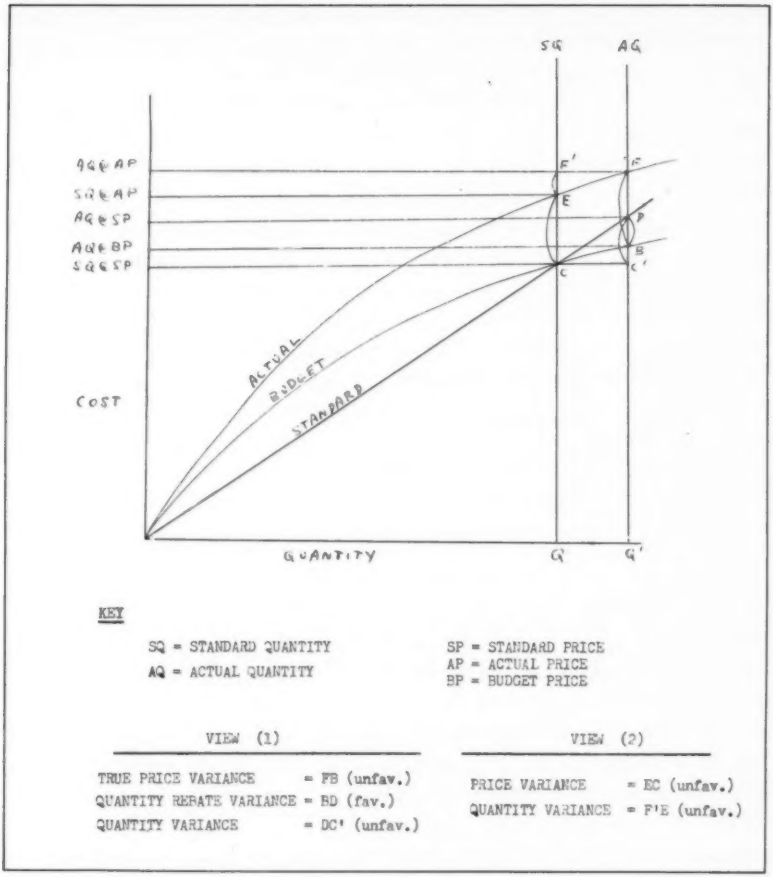

EXHIBIT I

homogeneous variance something that actually comprises two or more different elements. In the case illustrated, the time price variance would be substantially understated by the conventional method and, as an incidental consequence, so would the price-level variance, advocated earlier in this article. Since, for control purposes, the effectiveness of standard costing depends on our ability to recognize the true significance of variances when they appear, their correct analysis is of no little importance. To say this is not to lose sight of the fact that, in practice, some of the distinctions which have been drawn here may involve quite

small sums of money and, thus, may not be worth worrying about. Yet, if the calculations are not made, it may be impossible to say whether the amounts are big enough to be important or not.

We can also use Exhibit 1 to illustrate another ambiguity which surrounds price and quantity variances, and perhaps always will. If we look at the diagram again, we can see that there *is* an alternative way of analyzing the total variance between the price and quantity effects. On this alternative view, the quantity variance, i.e., the cost of using more than the standard quantity of material, is to be determined by evaluating the excess quantity at the actual price, not at the standard price. The price variance is arrived at by applying the excess price (excess of actual over standard) to the standard quantity of material, not to the actual quantity. The difference between the two views which we are contrasting can be briefly summed up as follows:

Let P = Standard price.

Q = Standard quantity.

$\triangle P$ = Excess of actual price over standard.

$\triangle Q$ = Excess of actual quantity over standard.

Then standard cost is QP and actual cost is $(Q+\triangle Q)(P+\triangle P)$. Multiplying out this expression for actual cost we get $QP+Q\triangle P+P\triangle Q+\triangle Q\triangle P$. The last three terms in this expression make up the total variance. Both of the views we are discussing allocate the first of these terms to the price variance and the second to the quantity variance. The argument is about what to do with the last term, $\triangle Q\triangle P$. The first view regards it as part of the price variance, the second as part of the quantity variance. The diagram on Exhibit 1 makes it easy to compare the two alternative sets of variances. The total variance is, of course, the same in both cases.

This is not by any means an empty argument, for it is concerned with the allocation of responsibility for the incurrence of cost. Suppose both price and quantity variances are unfavorable. Are the people in the plant who waste or spoil material to be held responsible for its actual cost or its standard cost? They will probably argue that any extra price paid was due to bad purchasing. Are the purchasing people responsible for the extra cost of all material used or only the standard quantity? They will argue that, if the material had not been wasted in the plant it would not have to be bought at the extra price. I do not know how to answer these questions, any more than I know whether, when I drop a glass on the floor and it breaks, this is because of the hardness of the floor or the fragility of the glass. The answer usually given in theoretical discussions is that $\triangle P\triangle Q$, which is what we are talking about, ought to be

assigned to a special "composite variance" account and excluded from both price and quantity variances; but it does not seem that this is often done in practice.

Incidentally, what happens to the quantity rebate variance if we adopt what may be called the "second view" of price and quantity variances? The answer is that it vanishes. The formula for the quantity rebate variance is, on the first view, AQ(BP − SP). In relation to the actual quantity, BP and SP need not be equal to each other, and so the quantity rebate variance is SQ(BP − SP). In relation to the standard quantity, BP will normally equal SP, so BP − SP = O and the quantity rebate variance vanishes.

Overhead Variances

Turning now to overhead variances, again there are reasons for thinking that while the conventional methods of variance analysis are often too complex to be easily understood by laymen, they are at the same time too simple to have the significance which they purport to have. A fuller discussion of this matter can be found elsewhere.[6] The topic will therefore be taken up only briefly here.

Common practice gives us a choice of perhaps three ways of analyzing overhead variances:

1. The two-variance method of analysis splits up the total overhead expense variance into so-called controllable and noncontrollable portions. It does this by means of a flexible budget which sets a budget allowance for overhead expense by reference to the output achieved for the period. We then have:

Controllable variance	= Actual expense − Budget allowance
Noncontrollable variance	= Budget allowance − Standard overhead cost of output (i.e. absorbed overhead).

2. The three-variance method of analysis uses a flexible budget which sets the overhead budget allowance by reference to some measure of input (usually man-hours) instead of output. The total overhead expense variance is then split up into three parts, thus

Budget or spending variance	= Actual expense − Budget allowance
Capacity variance	= Budget allowance − Actual man-hours × Standard overhead rate per hour
Efficiency variance	= (Actual man-hours − Achieved standard hours) × Standard overhead rate per hour.

[6] "Flexible Budgets and the Analysis of Overhead Variances," David Solomons, *Management International*, Jan.-Feb. 1961.

3. A third method of analyzing overhead variances, if we can call it a method, is not to analyze them at all. This is all too common, but it is obviously very unsatisfactory.

The two-variance and three-variance methods both have their merits and demerits. With the two-variance system, the so-called controllable variance is made up of several different things. In terms of an unfavorable variance, it might contain various kinds of price variance (some of which are certainly not controllable in the ordinary sense of the word), as well as expense which was incurred only because control of spending was lax. Less obviously, it may also include part of what is really an efficiency variance — the incremental overhead expense incurred through the employment of more man-hours than were warranted by the achieved level of output. The controllable expense variance is conglomerate indeed. The noncontrollable variance is homogeneous in that it consists wholly of unabsorbed fixed expense; but the under-absorption may be in part the result of having idle capacity and in part the result of misuse of capacity so that it does not make its full contribution to output.

The three-variance method does purport to give an efficiency variance but, as conventionally calculated, it represents the difference between the overhead expense actually absorbed at the standard rate by the output for the period and the overhead which would have been absorbed if the manpower employed had been used with standard efficiency. This, I suppose, is one of many possible definitions of the cost of inefficiency, but it is to be doubted whether it is one of the most useful. With this system too, as with the preceding one, the budget or spending variance which is arrived at is far from homogeneous.

A further defect of both the methods just discussed lies in the over-simple nature of the cost function used in forming the flexible budget. The two-variance method treats overhead as simply a function of output, while the three-variance method treats overhead as simply a function of some particular input, usually direct labor. Realistically, overhead is much more likely to be a function of several variables, and certainly of both input and output, to say nothing of other parameters.

Once the trouble has been diagnosed, the remedy is, in theory at least, easy enough to see. We need:

1. *A flexible budget* which takes into account the effect of at least two independent variables, output and input (probably expressed in terms of manpower), on the budgeted level of overhead expenditure. This can be drawn up by separating overhead expenses into three categories: those which are responsive to changes of output, those which respond to changes of input and those which do not respond to

either.[7] This more flexible budget would make possible the calculation of a more meaningful budget variance and a true efficiency variance.

2. *A more meaningful budget variance.* Defined in the usual way, budget variance is the difference between actual expenditure and the budget allowance. Since the adjusted budget figure would now make allowance for extra spending on overhead caused by any misuse of manpower (if that is the parameter chosen to represent input), this extra spending would not get into the budget variance and it would become, to that extent, a little less heterogeneous in its composition that it now is.

3. *A true efficiency variance.* This would be calculated by taking the input-responsive items of overhead and computing the variation they would be expected to show because the actual inputs used were different from standard. To take a very simple example, let us assume the standard manpower requirement per unit of output of 5 man-hours, output for the period of 1,000 units, 5,200 man-hours for the period, input-responsive items in the overhead budget of $10,000, and that these are expected to vary in direct proportion to manpower (the functional relationship in real life is, of course, more complicated than this). Then what I have called the true efficiency variance would be $\$10{,}000 \times \frac{200}{5000}$, or $400.

4. *A volume variance,* consisting of unabsorbed fixed costs, divided up into a volume (capacity) variance and a volume (efficiency) variance in order to distinguish between fixed costs unabsorbed because of unused capacity and fixed costs unabsorbed because of misused capacity.

Shortcomings Provide an Opportunity

Standard costing is the victim of its own pretensions. Job costs and process costs of the old-fashioned historical kind offer little or no information which is directly relevant to the control of costs and, therefore, are not subject to criticism for failures in this field. But with standard costing it is different. Though, as was said earlier, it is a versatile tool, with many uses, its greatest contribution is in the field of cost control. Its shortcomings are liable to criticism, simply because it has such tremendous potentialities. These potentialities have really only just begun to be explored. In the development of concepts, in accounting as in other fields, half a century is not a long period. So if, as has been suggested here, standard costing in its present form is still too simple an instrument to provide more than a part of the information which cost control demands, if it is to be really effective, we are entitled to regard this as an opportunity, not a failure.

[7] This is still an over-simplification. We really need more categories still.

Capital Gain for Forfeited Deposits on Containers

by IRVING S. HOFFBAUER*

A RECENT DECISION of a case in the Court of Claims in favor of a taxpayer, should have some interesting developments in the accounting for returnable containers. The court allowed capital gain treatment for forfeited container deposits taken into income.

In the taxable year and preceding years, the taxpayer sold its product in heavy steel cylinders on which its customers were required to make a deposit. The taxpayer retained title to the cylinders, which were to be returned in good condition within 90 days or the deposits were to be forfeited. The taxpayer was more interested in having the cylinders returned, however, than it was in keeping the container deposits. Whenever it had to get new cylinders to replace those not returned, it incurred additional administrative burdens in purchasing and in testing and accounting for them in compliance with interstate commerce regulations. Because it wanted the cylinders back, the taxpayer returned the deposits even when the containers were brought back long after the 90-day period had expired or in a damaged condition.

In a certain year, the taxpayer took into its income the cylinder deposits on a number of cylinders which were not returned within three years from shipment and it claimed capital gain treatment. The Court of Claims allowed such treatment.

Other pertinent factors the court took into consideration were:

1. The cylinders were not held for sale in the ordinary course of business.
2. The taxpayer did not manufacture and inventory the cylinders.
3. It used and treated the cylinders as delivery equipment.
4. It did not promote the sale of cylinders.
5. It tried to make sure that cylinders would be returned.
6. The containers were of great strength and had extreme durability and a useful life of many years.

Another significant factor which had an important bearing on the results of this case was the recognition of the court that the disposition of the cylinders was either a "sale or exchange" or an "involuntary conversion." The durability of the containers had an important bearing on this point since the court distinguished this case from a supreme court decision involving a bottling company in which the containers were soft drink bottles. In that case, the court held the forfeited bottle deposits were ordinary income as the bottles were broken or destroyed at some time before the deposits were taken into income and, therefore, could not have been sold, exchanged or involuntarily converted.

If your company fits the situation in the case outlined, it would seem to be worthwhile for you to file claims for refund for any open years. If the claims are not allowed, you should then consider a suit filed in the Court of Claims. Before this is done, make sure that you can show the deposits are treated as liabilities, the containers are your own property, that you are more interested in having the containers returned, that you do not hold the containers for sale, and the containers were durable enough and had a sufficiently useful life so they were still in existence at the time the deposits were taken into income, so as to show there was a sale.

Companies now selling containers which are durable might consider applying for permission to switch to the deposit method to take advantage of the above decision.

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Organizational Aspects of Inventory Management

by STANLEY Z. BRONNER

A GREAT CHANGE is taking place throughout our economy, bringing with it a correspondingly profound change in the relationship among production, sales and inventory replacement. It is the change in inventory patterns at all tiers of the production-distribution systems. There are many reasons for this change — ample or excess capacity, shorter lead times, price stability and foreign competition, to mention a few. But there is another factor — it is the growing awareness of the importance of inventories in the scheme of things. This awareness has been long in developing but the remedial action required at the hundreds of thousands of individual decision-making points in our industrial and supply complex has been even slower in taking form. However, there are definite signs that industrial and commercial managements not only recognize the erratic demand pattern occasioned to a large extent by inventory mismanagement with the consequential waste, lay-off, re-employment, overtime operation and inventory over-investment, but that they are also taking specific steps to manage inventories in a manner designed to lessen the effects of inventory accumulation and "de-accumulation."

The Impact of Inventory Fluctuations

In an attempt to bring sharply into focus the problem brought about by widely fluctuating inventories in contiguous operations of transactions, I shall, at the risk of oversimplification, present the following illustration. In this illustration, the basic cause for fluctuation is the multiplying factor present in a series of inventory levels in a supply system, where the practice is to adhere to simple, fixed inventory rule of four weeks supply. (There can be other basic causes of fluctuation, of course.) Exhibit 1 illustrates the effect of a one-unit increase in ultimate demand. Exhibit 2 illustrates the effect of a one-unit reduction in ultimate demand.

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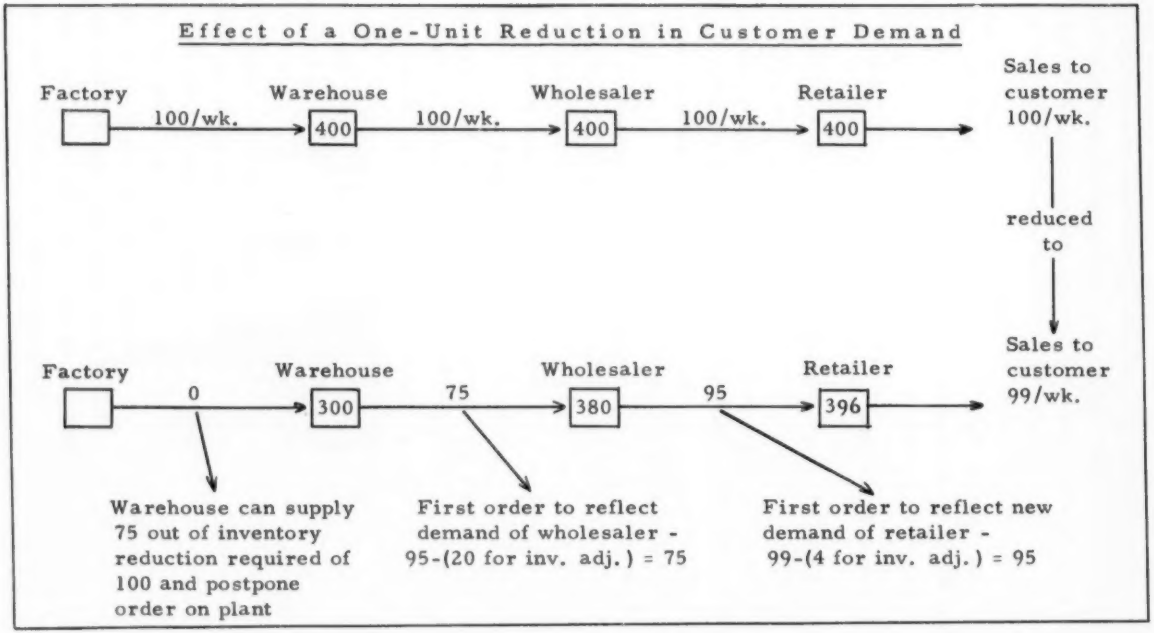
Effect of a One-Unit Increase in Customer Demand
Factory
Warehouse
Wholesaler
Retailer
Sales to customer 100/wk.
100/wk.
400
100/wk.
400
100/wk.
400
increased to
Factory
Warehouse
Wholesaler
Retailer
Sales to customer 101/wk.
225
500
125
420
105
404
First order to reflect demand and inventory buildup -
First order to reflect new demand and inventory build-up of wholesaler -
First order to reflect new demand and inventory build-up of retailer -
125 & 100 = 225
105 & 20 for inv. adj. = 125
101 & 4 for inv. adj. = 105

EXHIBIT I

EXHIBIT 2


Effect of a One-Unit Reduction in Customer Demand
Factory
Warehouse
Wholesaler
Retailer
100/wk.
100/wk.
100/wk.
400
400
400
Sales to customer 100/wk.
reduced to
Factory
Warehouse
Wholesaler
Retailer
0
75
95
300
380
396
Sales to customer 99/wk.
Warehouse can supply 75 out of inventory reduction required of 100 and postpone order on plant
First order to reflect demand of wholesaler - 95-(20 for inv. adj.) = 75
First order to reflect new demand of retailer - 99-(4 for inv. adj.) = 95

One way to prevent or minimize these wild fluctuations would be a "feedback" mechanism from the end of the supply chain back to any of its links. For example, warrantee cards on appliances can give the manufacturer a better idea as to what demand actually is, so that he would not be unduly influenced by temporary and nonrepresentative changes in demand.

To act on this knowledge at times would mean acting contrary to what is usually considered good business practice.

Matching Production to Demand

In the situation illustrated, since the factory had no demand on it, the usual steps to take would be to reduce production to the minimum. However, if through feedback, the manufacturer were made aware that the changed demand did not truly indicate a fundamental change in customer demand, the better steps to take would be to produce the 75 units and to store them for sale in subsequent weeks, thereby damping the fluctuations.

Conversely, if the situation were reversed and a slight nonrepresentative upward change occurred at the retailer level, the effect at the factory would be multiplied and changed demand would be in excess of 75. Theoretically, the manufacturer should continue to produce only 75; but, realistically, should, for instance, an order be received for 100 units, it would be difficult to convince a plant manager that he should produce only 75. However, the knowledge of effects of increasing production will influence his judgment to the extent that he would modify his decision-rules and produce less than the indicated demand, making up the difference through withdrawal from inventory.

What is demonstrated in these crude illustrations actually takes place in varying degrees throughout the business world. Take the automotive industry as a case in point. A small percentage variation in retail sales is reflected as a larger percentage change at the assembly plant and a still larger percentage change in automotive steel purchases. A comparison of automotive sales over the past two years by months with steel procurement for automotive use, reveals much steeper and bigger rises and dips in automotive steel orders than in automotive retail sales. In this connection there appeared a very interesting article on inventories in the April 11, 1961, issue of *Steel Magazine*, describing how the steel inventory levels have whipsawed since mid 1956. The article notes the buildup of steel inventories by users to a record high of 26 million tons by April 1957 despite assurances of labor peace for more than two years. According to Mr. Alan Greenspan, quoted in the article, wide fluctuations in steel inventories are caused in many instances by changes in lead times. He suggests that

steel managements find ways of holding lead time to a more uniform pattern. In a broad concept of inventory management, the accomplishment of this objective would constitute just another facet of this function in the steel industry.

An Example

The brass mill products industry provides an example of changing inventory management on the part of its customers which, in turn, forces the industry to change its own concepts of inventory management. A look at the chart (Exhibit 3) gives some idea of what has happened since the first of 1954. The chart attempts to measure statistically when brass mill customers are building inventories or reducing them. When shipments from the mills to customer exceed the rate at which metal is being cut up in the customer's shops, the amount of buildup is represented by the bars above the zero line. When the opposite is true, the

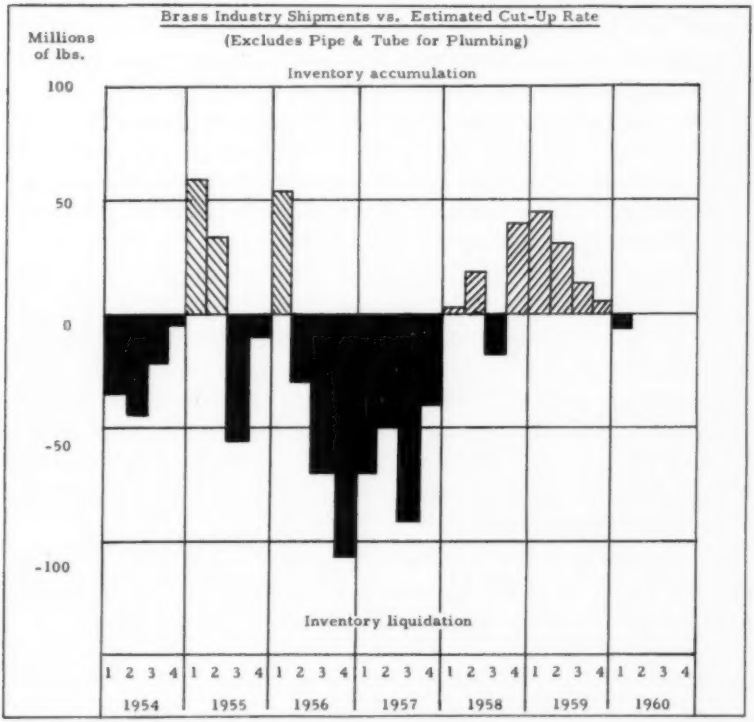


EXHIBIT 3

amounts of liquidation are represented by the bars appearing below the zero line. For the purpose of this analysis, which is updated on a quarterly basis, we have developed a statistical method of determining the rate at which brass customers are cutting up brass. These estimates give the approximate evaluation we are seeking. Incidentally, the evaluation is extremely helpful in short-term sales forecast of brass mill products demand.

From the amount of accumulated liquidation during the years 1956 and 1957, it is quite apparent that customers have changed their brass buying pattern. They now insist on quicker delivery and are getting it. The change has had a beneficial effect to both the customers and the industry itself. It minimizes the risk of inventories on the part of customers. Because the prices of copper base material are so volatile, customers with large inventories in the past have been often forced to take large losses. The result of this bad experience tends to build resistance on the part of customers to the use of copper base material in their components and, in fact, inspires them to seek substitutes. This has naturally been detrimental to the interests of the brass products industry. Now, due to the fact that lead times have been greatly reduced, customers do not carry the large quantities of inventories they previously did. This has lessened customer's reluctance to find more uses for the copper base material, a result beneficial to the industry, although the industry has had to increase inventories to improve delivery service. The industry is also forced to do a better inventory management job within its own operation. Thus it can be seen that both customer and supplier have benefited from this development.

In our company we are giving considerable thought and study to the whole subject of inventories and through the application of operations research techniques, in conjunction with electronic data processing equipment, we are hopeful that our efforts will be as rewarding as we think. For one thing, we are trying to refine a prediction technique which will enable us to complete more processing on lots of material even before the customer had made up his mind as to what and how much he will require on his next order. Also, a feed-back mechanism from the Bureau of the U. S. Census is now available on certain kinds of end-use information.

The discussion up to this point has been designed to demonstrate the importance and magnitude of the inventory problem and the impact of changing inventories on the country, the buyer and the seller. In a very general way, it also suggests possible action which might be taken and also evidences of action that has already started. The remainder of the discussion is intended to be more specific on concepts and organization for improved inventory management within a company.

Inventory Management — Concept and Objectives

It may be in order, first, to draw a distinction between the terms inventory management and inventory control. Too frequently the latter term carries with it the connotation of a system of stock replenishment involving, in some cases, highly sophisticated techniques. Or, the term might simply refer to the system of reporting data on receipts, disbursements, transfers, shipments and balances. Or, it might mean only the dollarized reporting at periodic intervals of balances grouped in certain categories by product type, location of department, to which subsequently are applied predetermined and perhaps arbitrary measurements of turnover ratios to indicate excesses or understocked conditions. Inventory management, on the other hand, for the purposes of this discussion, is intended to be a much more comprehensive managerial concept.

For a manufacturing company, inventory management can be defined as the planning, scheduling, and controlling of all production materials requirements from the moment materials for production become the possession of the company through all the stages of processing or fabrication until, in their converted form, they are shipped and billed to the customer for whom they were intended. Thus, materials or inventories in this definition include raw materials, purchased parts and components, work-in-process, semi-finished products and finished products awaiting sale. This concept clearly defines the objectives of inventory management. There are four principal ones.

The first is to improve customer service. This means having the right material in the right place at the right time and of the proper quantity and quality. This objective is placed first in importance because, under many competitive situations, service is one of the prime factors in keeping old customers and in getting new ones. It has become all the more important because of the trend of the times. Industrial customers generally are forcing more of the inventory burden on the supplier.

The second objective of this concept of inventory management is to lower operating costs. In many companies one of the greatest opportunities to improve profit potential lies in the area of refinements in the production planning and inventory management procedures. During the last ten years, particularly, there have emerged tremendous improvements in the science of establishing inventory policies and systems of decision-rules designed to balance the many, often conflicting, factors to be dealt with, such as minimum carrying cost vs. long production runs, large purchase quantities, low freight rates, stock-out risk and the like. The new techniques, accompanied by the rapid development of electronic data processing tools, have helped in promoting the application of the scientific methods. In addition, some of the intangible factors which earlier could not be included in these studies can now be evaluated.

The third objective is to reduce inventory investment to a point where it represents maximum return on the investment consistent with all other considerations. This objective has also taken on new significance because of the high cost of money, the increases in property taxes generally throughout the country and because of the previously mentioned pressure on the part of customers to unload a good part of their inventory burden.

The fourth objective is to stabilize employment. Industrial and business managements have been giving greater study and attention to this phase of operations. Many companies have already completed evaluations of the effects of fluctuating manpower requirements on so-called "personnel costs." These companies know how much costs are increased by changes in the size of the work force and how much profit improvement can be accomplished by avoiding or minimizing these changes. Personnel costs in this connection include overtime premiums, training, hiring and layoff, transferring between departments under seniority rules of the union contract, unemployment compensation, lower employee morale and damage to a company's reputation and to its community relations.

Intracompany Controversies as to Inventory Management Functions

Now that we have summarized four of the principal objectives of inventory management, what are the things which must be done to make sure we are pointed in the right direction toward the achievement of the full benefits which can come from inventory management?

There are many things, of course, and they include the obvious — making sure we have the most modern tools, machines and techniques in the field. In addition, there are many things to do which may not be so obvious. These would include training not only the operating personnel in the techniques and procedures but, more important, the management team. This is necessary to be assured that the inventory management function is properly understood and accepted.

While, in many companies, the dollar value in inventories represents the largest single item of investment appearing on the balance sheet, concern with inventories as such is subordinated to other interests in it. To the sales department, product inventories are the means for competing for customers and markets, and sales people are naturally inclined to want an abundance of everything. This motivation is exactly opposite to that of the finance department which is always seeking lower inventories because, to the financial mind, inventories absorb working capital funds — usually too much. To the manufacturing department, or the production man, they are an element of machine loading and

manpower planning. His first driving interest is to keep his facilities and manpower supplied with an even flow of material to work on. In other words, the principle of inventory management is here subordinated to keeping the shop occupied. The engineer's interest in production materials is confined to matters of product design, performance, reliability and quality. The desire of procurement people is usually to maintain higher inventories in their raw state or in purchased components before assembly, because this provides greater flexibility as changes in production quantities or product mix occur. It is only natural for them to prefer to see greater curtailment in the categories of work in process and finished goods when it becomes necessary to reduce total inventories.

With all these varied and often opposing interests, if there is no person responsible for the function of inventory management, one can be sure that the factors deserving direct and primary inventory consideration will get little or no attention. In most cases, this neglect can be very costly. Subsequently, but perhaps not so apparently, the action taken results in missed production schedules, poor delivery service, high spoilage or rejects and, even worse, customer dissatisfaction.

Organizing Inventory Management

The way to overcome this difficulty presents itself in the form of an organizational function created with sufficient management stature to be responsible for the inventory management activity.

There appears to be two general ways to set up this function. Some companies, advanced in the appreciation of inventory management importance, have given the function line responsibility and authority. This has been effective but can be difficult for the existing organization, because the approach is bound to "step on the toes" of many in an existing organization structure.

Another way is to organize a staff function for the purpose, again with adequate organizational stature and acceptance. The function will perform in two primary areas: first in the development of concepts, techniques and procedures, secondly, but more importantly, in taking active, current leadership in the coordination of each of the other functions interested in or affected by inventory management. Usually, the functions most affected would be those of sales, production and procurement. The four functions would coordinate their activities in carrying out periodic plans and so form a framework within which their operational activities are to be conducted.

It is necessary also for the inventory function to establish appropriate relations with the engineering and financial or controllership functions. With respect to the latter, the new concept of inventory management may require different kinds

and changed standards of inventory measurements. For example, turnover ratios reported in operating statements by accountants are usually based on the activity of the most recent month or quarter. It may be more desirable to use those planned for a forecast period ahead.

The word forecast brings to mind the importance of the sales forecast to inventory management. Many times the success of inventory management is largely dependent on the ability to forecast sales accurately for the short-term period covered by the planning part of the inventory management routine. The experience of many companies in preparing reliable short-term sales forecasts have been disappointing, to say the least, but the need for more reliability in demand forecasting is becoming so evident that the subject is commanding more interest and attention than ever before.

Sales forecasting in many industrial cases is extremely complex, and the many problems are difficult to solve. This is fully recognized. However, the observation is made that part of the difficulty stems from the possibility of having misplaced the responsibility for forecast preparation. Perhaps the people who are doing it may not understand fully the planning aspects of the forecasts. They may be influenced by other considerations such as would be the case if the figures were used also for financial planning. Short-range forecasts, where they are prepared by the sales department, are likely to be colored by sales optimism or pessimism or even indirectly by pressure exerted on the sales department by management. Therefore, the responsibility for the sales forecasts used in current inventory planning should perhaps be placed with the inventory management function, which of course, would work closely with the sales department and/or market research function, with the further understanding that the latter would be responsible for the long-range forecasts used for product planning, expansion, etc. The reliability of forecasts within reasonable limits is a must in the successful development of inventory management.

The present-day concept of the optimum inventory embraces the function of balancing out all factors involved so as to determine the best combination rather than concentrating on maximizing a few factors.

The determination of profitability as applied to inventory management must go beyond the measurement based on the turnover rate and take into account hidden costs. For example, usually profit does not reflect the cost of the lost sales, which could result from pressure to increase turnover. Therefore, to more precisely define what we are trying to accomplish with today's concept and implementation of inventory management — we should re-state the old turnover-profit relationship as "the more times the manager can turn over his inventory while optimizing all cost factors, the better assured he is of obtaining the maximum result on his investment."

Synchronized Inventory Control — One Company's System

by HERBERT H. SEIFFERT

CONTINUAL development of executive talent through the application of the principles of decentralized organization is one of the basic characteristics of our company's approach to the problems related to management. Accordingly, the responsibility for inventory investment is not assigned to any one functional area but rather to a composite of several areas that serve as checks and balances — to one another.

With this in mind, then, the present paper is segregated so to cover the four functional areas — sales, production, purchasing, and controller's, that pool their efforts towards meeting the basic objectives of our inventory system:

1. Optimum customer service (having stocks of finished goods available to meet customers' orders at all times).
2. Level employment (maintaining a stable workload within the limitations of machine flexibility and advance knowledge of requirements).
3. Economical operation (production scheduling so as to obtain economical utilization of the facilities and equipment).
4. Minimum investment in inventories (calculating every requirement for inventory and weighing the need for it against the cost, including the space considerations).
5. Realistic vendor relationships (a good working relationship with the suppliers of both raw materials and purchased finished goods).

Sales Department's Responsibility; Sales Plan Record Sheets

The initial and by far the most important single document governing our total inventory investment is the Sales Plan Record sheet (Exhibit 1). These sheets reflect the anticipated orders to be received from customers in units of product, by month, by shipping point, as well as the safety margin to be maintained. Our sales coordination director (marketing research department) has prime responsibility for the issuance of these sheets on a national basis. It is on the basis of the volume as recorded on these sheets that the point of manu-

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EXHIBIT I

PAGE 1

SALES PLAN RECORD

Year 1961

PRODUCT 30 - Baby Powder UNIT Dozen Cans CODE 3023

ITEM Economy Size Std. Price $ 0.00 Cur. Price $ 0.00

Expressed in Dozens of Units

SAFETY INVENTORY	NO. PLAN	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
N. B.	8-26	2,500	2,800	3,200	3,000	3,000	3,200	3,800	3,300	2,800	4,600	4,000	3,800	40,000
3,000														
CHI.	8-26	2,400	2,500	2,600	2,550	2,450	2,600	3,100	2,800	2,500	2,650	2,050	1,800	30,000
2,500														
M. P.	8-26	1,800	2,000	2,100	2,050	2,000	1,750	1,800	1,775	1,625	1,750	600	750	20,000
2,500														
DAL.	8-26	2,200	2,500	2,800	3,600	4,200	4,400	4,950	4,550	4,500	5,700	5,600	5,000	50,000
4,500														
TOTAL	8-26	8,900	9,800	10,700	11,200	11,650	11,950	13,650	12,425	11,425	14,700	12,250	11,350	140,000

facture — scheduling of shifts, material, labor and burden requirements, and income data will be developed for the ensuing calendar year.

The first cut-off date for the submission of sales plan records is the middle of September for inclusion in the forthcoming year's forecast. At that time, working independently of the data reflected on them in units, our sales coordination director develops a total dollar forecast by major product groups. This serves as an initial check point, since the sales plan records reflect the latest thinking of the various product directors, whereas the coordination director, having years of experience with the company products and being well versed in national economic conditions, is able to make a fairly accurate estimate of what our projected sales should be. His dollar estimate is then compared with a machine accounting run which has extended the sales plan records at realizable selling prices by product on an annual basis as follows:

Manufacturing point.
Shipping point.
Units.
Selling price.
Total sales dollars.

If there are any significant differences between the coordination director's estimate and the extended sales plan records, a revised copy is prepared on the original sales plan record sheets to reconcile the two. Either revised or accepted by product group, they become then the source data (volume) for establishing standard costs.

FINISHED GOODS ORDERS, PRODUCTION AND INVENTORY

A QUANTITY-ONLY REPORT

LAST S.O. NO. _____ LATEST BRANCH RELEASE NO. _____ SERVICE POINT New Brunswick DATE OF TRANSACTION _____

LOC.	MFG.	PRODUCT CODE	UNIT	PRODUCT DESCRIPTION	CLASS	INV. ADJ. TRANSFERS ETC.	BRANCH ORDERS ACTUAL TO DATE	BRANCH ORDERS BRANCH PLAN	SALES ADJUSTED FORECAST	SALES ACTUAL TO DATE	SALES ACTUAL THIS DAY	PLAN BALANCE	PRODUCTION ACTUAL TO DATE	PRODUCTION ACTUAL THIS DAY	PRODUCTION ADJ. BASE INV. BASE	PRODUCTION E.O.M. PLANNED INV.	BOOK INVENTORY
Production Center →			P. C.	PLANNING VALUE	Cyclic designation				UNADJUSTED FORECAST			NET RELEASED	ACTUAL TO DATE (THIS MONTH)	ACTUAL THIS DAY	VAR. MIN. BASE	FORECAST MAXIMUM	
1	1	3	003023	85	Dz	Baby Pow Econ	A	40	1600	1600	3000	1500	325		3000		3000	4900	6000
					P.V.	2000					2600								

EXHIBIT 2

Throughout the year, sales plan records sheets are constantly being reviewed and changed as the anticipated figures are analyzed through daily comparisons to the Finished Goods Orders, Production and Inventory report (Exhibit 2). In addition, monthly meetings of the product directors with the sales coordination director are held to review any special situations warranting changes in anticipated orders.

Sales plan record sheets are prepared for new products too. Completely new products (those not homogeneous to existing product groups) are assigned new product group numbers and watched carefully. However, it is difficult to advocate any set rules in this area, for if any new product does not fulfill expectations in its introduction, the product director has the prime responsibility for both answering to management and the eventual product disposition.

The significance of all the above is that operating efficiency of the production and purchasing departments is measurable to a large degree by the accuracy of the information that is contained on the sales plan record sheets. If there is a delay in the furnishing of pertinent changes, second guessing or built-in personal safety margins, inventory imbalances, that would certainly be created, may be difficult to bring back in line.

Production Department's Responsibility

The company operates four principal service points out of which shipments are made to customers. A fifth location serves as an auxiliary point and services only hospital customers. Three of these locations are manufacturing centers, each having several mills.

Initially, manufacturing locations were to be complete entities in themselves so as to limit transportation charges between plants. The trend in recent years has been to manufacture national requirements of certain individual put-ups in one location. This trend recognizes the need for maximum use of manufacturing facilities in order to minimize excess capacity and eliminate duplicate facilities. Then, too, it would not be prudent to invest in facilities for the manufacture of a new product until the level of demand warrants extensions or expansion of production facilities. The result is that we now have many put-ups of products that are produced at one location for national distribution. These products bear a larger freight allocation on their respective product income statements and, out of necessity, a larger inventory must be maintained as insurance against back-order situations. On the other hand, these products reflect a lower cost by being produced centrally. With over 800 put-ups, our management recognizes the above as one of the factors causing our inventories to reach higher but explainable levels in recent years.

Manufacturing management's prime concern is having sufficient finished

goods available at the right time in order to satisfy sales management requirements. The first step in accomplishing this is the conversion of the sales plan record sheets volume for determination of shifts, material, labor and burden requirements, production centers and most advantageous points of manufacture.

On Exhibit 1 there is a space provided for safety and/or base inventory. Safety inventory, actually a certain number of days sales with allowable variances, is set by the sales department. There are exceptions, such as new products, modifications, new market areas, etc., when larger inventories are maintained in order to assure prompt customer service. However, these exceptions are watched closely and, as soon as logical patterns are developed, standard safety inventories are substituted. Other than the above, the only time a deviation from standard safety inventories can be effected is at the discretion of the production coordinator who assumes full responsibility for such deviation. The safety inventory may be adjusted for the items in those production centers where sufficient flexibility exists to generate additional stocks rapidly.

Each put-up has a predetermined planning value which is the normal production that can be expected from a normal shift of work, when the operation is working, less allowances for factors that will occur during the course of a normal month. Although on a shift-to-shift basis actual production may exceed planning value, over the period of a month total production should be in line with planning value because downtime, absenteeism, changeovers, material shortages, etc., will have occurred. Planning values are reflected in Exhibit 2.

In addition to the safety and/or base inventory and in conjunction with planning values, production categorizes its finished-goods inventory as follows:

Working inventory: Created during the period that production exceeds sales to be used when sales exceed production. Working inventory contributes towards satisfying the basic objectives of level employment and economical operation.

Cyclic inventory: Produced in cycles, because it is produced on the same machine or line as another product, and where it is not desirable to run a small-volume product each month of the year. The formula for the determination of the equitability of carrying inventory versus changeover, arriving at the optimum number of units (T) in a run, cost is as follows:

CYCLIC INVENTORY DETERMINATION FORMULA

A Average investment in inventory
B Cost of money before taxes (use company standard)
C Average number of pallets in inventory

D Cost of storing one pallet for one year
E Cost of changeover for one year (start up and shut down out-of-pocket)
G Units produced per shift
H Average sales per working day
J Number of shifts per day
K Cost per unit as standard
N Number of shifts in run
P Units per pallet
Q Cost of one changeover
R Working days in year
S Annual forecast sale in units
T Units in run
Y Shifts from beginning of one run to beginning of next run of same product

(1) $(AB)+(CD)=E$

(2) $E=\frac{\frac{H}{(G-J)}\ NKB}{2}+\frac{\frac{H}{(G-J)}\ ND}{2}=\frac{QRH}{NG}=\frac{QS}{NG}$

(3) $N=\sqrt{\frac{2QS}{\frac{H}{G(G+J)}\ \frac{D}{(KB+P)}}}$

(4) $Y=\frac{N\times G\times J}{H}$

(5) $T=N\times G$

Replacement inventory: Needed only at a branch plant to assure the branch of an adequate stock position during that period between the release and receipt of the new shipment from the supply point.

Minimum inventory: At the supply point, this is the adjusted local base and/or safety inventory plus the cyclic inventory. At the branch point, it is the adjusted local base and/or safety inventory plus the replacement inventory.

Maximum inventory: When sales are under forecast, inventory can be exceeded to the extent of the base and/or safety inventory range.

Using the latest finished goods source of supply index, which lists by product and by put-up the most advantageous point of manufacture, the production staff incorporates its annual volume forecast, through the use of an electronic data processing computer, into a manufacturing schedule. Since sales plan record sheets are being

changed periodically, almost the same elaborate calculation is required monthly and annually to up-date manufacturing requirements. The annual run-through is for the determination of cost standards. Once these are established, all inventory is costed at these standards with subsequent volume changes and their effect on standards charged or credited to manufacutring variances.

One of the most serious situations that can befall the manufacturing department is getting into a back-order position. Although this point will be expanded upon under the controller's responsibility, it is mentioned here because it is basically a manufacturing problem. Our fourth basic objective, minimum investment in inventories, is practiced religiously. We carry use and occupancy insurance as protection against physical disasters. Our company has an enviable record in labor relations; the incidence of strikes, which could affect inventories, has been nominal. Built into the planning schedules is an allowable quality control inspection interval. The quality control department is constantly inspecting finished goods prior to their transfer to the shipping department. If only the slightest defect is uncovered, a whole batch could be impounded. A decision must then be made to either produce another batch, creating manufacturing under-schedules and building inventory, or ship from another location, if material is available, incurring added freight costs.

Purchasing Department's Responsibility

At the time that the annual volume is established by months, the IBM cards are fed into the computer for what we refer to as a raw material requirements explosion. This tabulated run will disclose every raw material component needed to produce the annual finished-goods requirements. On an annual basis this gives purchasing management a general idea of what its responsibility will be for the forthcoming year. The purchasing department must decide whether to buy for quantity prices as measured against the cost of carrying such raw material. Foreign supply markets must be reviewed. The possibility of outside strikes is also a heavily-weighed factor. Once again, business judgment, based upon a sound knowledge of economics, comes into play.

Monthly, based on the recalculated manufacturing schedule, purchasing department is supplied with a schedule from production of raw material requirements. Theoretically, every time a sales plan record sheet is changed, production and raw material requirements change. Under-schedules (material scheduled for use in production one month but not used that month) can cause serious raw material imbalances. Under-schedules can be caused by back-order positions that, in turn, cause immediate production rescheduling within the month, with originally planned schedules put aside. Another reason could be component material parts missing.

The purchasing department also has responsibility for the negotiation of delivery schedules for purchased resale items. Inventory-wise this usually results in the maintenance of excess inventory, since most suppliers do not agree to sell their products on a seasonal basis. This means that, although the company's season for the purchased finished goods may be during the summer months, the inventory is maintained on a level basis throughout the year.

The above points are disclosed to, understood and accepted by our management.

Controller Department's Responsibility

The controller's department has the responsibility for servicing the three previously mentioned areas of management in whatever way it may contribute toward achieving the five basic objectives of the over-all inventory system, with reporting responsibility directly to the president.

The controller's department is organized functionally with each division playing a large part in the control of inventories. Foremost in the control and measurement of inventories is the budget and cost division. The assistant controller heading it has the prime responsibility for coordinating and directing the efforts toward establishing each year's new standard product costs.

Since inventories are costed at standard, any change in standard costs will affect the total inventory investment. Annually, a comprehensive planning calendar is established that lists, practically on a day-to-day basis for the fourth quarter, the tasks to be performed in order to complete new product costs. Commencing with the volume as reflected on sales plan record sheets, it is examined to see that a plan has been received for every put-up that is expected to be sold in the coming year. Department managers are contacted by cost men to discuss changes in production planning, material standards are established, labor standards and burden budgets prepared and cost sheets completed and compared with prior years' standard costs. A standard cost of sales report for the forthcoming year is released and income statement work papers reviewed.

The assistant controller of the budget and cost division also has responsibility for the physical taking of inventory, the date being at his discretion. Other responsibilities include the forecasting of inventories on a quarterly basis, as well as monthly accumulation and reporting of raw material, work-in-process and finished-goods inventories. A substantial portion of his efforts is directed to cost reduction programs at the various manufacturing locations, which ultimately results in a lower investments in inventories.

The management services division is comprised of electronic data processing, machine accounting and systems and

procedures groups. The assistant controller heading such a group has the prime responsibility of devising ways and means of up-dating the reporting structure through the most advantageous use of the computer. The total finished-goods inventory is programmed on the computer with the end product being the Finished Goods Orders, Production and Inventory report (Exhibit 2), prepared on a daily basis. At the present time the computer is scheduled on a three-shift operation.

The systems and procedures groups serve the other divisions of the controller's department in a staff capacity. They are referred to special situations that require depth studies, such as the flow of finished goods between production and shipping. In their endeavors, the division's staff attempt, through the issuance of formal procedures based on their findings, to tie up any loose ends that might create loss of inventory control.

Still another area in the controller's department is a special group, that is working on the basis of the data on the daily order production inventory as displayed in the finished goods orders, production and inventory report. The group is headed by the inventory control manager, who is responsible for interplant liaison with regard to inventories and their movement between plants. This responsibility involves taking action in the event of unanticipated large orders, back orders, shortages or overages in interplant shipments and corrections of book inventory after physical inventory-taking, to assure, whenever possible, uninterrupted customer service.

The accounting division, among other things, encompasses the accounts payable group and the financial statements group. In the former all vendors statements are settled, with elaborate controls set in to see that duplicate payments are not made and that raw material has in fact been received or matched against payments where discounts are involved.

The prime responsibility of the assistant controller of this division, however, is the monthly reporting to top management on actual performance. From a reporting point of view his position becomes precarious. On one hand, sales management is interested primarily in the finished goods position from a standpoint of availability to meet customers' orders as they are "booked" but not necessarily billed. On the other hand, the assistant controller's reports reflect sales only when they are billed to customers, not when the order is accepted by the company. Although our business is fairly level throughout the year, there are periods when serious differences between billed and shipped occur. In these particular periods, extensive reconciliations are made in subsidiary reporting to assure management that orders received are being billed.

In measuring inventories, we always look objectively at the current forecast

without regard to last year's performance. We do a disservice to management if we relate to historical trends rather than to anticipations. In explaining inventory variances, we consider price increases and decreases, loss of and/or gain in sales, new products, discontinued products, quality control "credo," because we feel reasonably confident that our inventory levels are where they should be based — on the current sales forecast. For the past seven years, and for the next three years based on projections, our inventory turnover rate on an annualized level has held very constant with only nominal fluctuation. As long as our product lines continue to change (and they must in our highly competitive economy) with attendant additions of products creating new bases of inventory and manufacturing locations creating more lead time, etc., rather than keeping our production as is, and depending on population growth for expanded sales, we are going to experience a creeping up, year by year of our total dollar investment in inventory.

Co-operative Responsibility

Through the contribution on the part of the four major functional areas, an inventory system has evolved under which no one group takes the so called "blame" for imbalances. Rather, through the checks and balances in the four major areas, and the interdepartmental checks and balances within the controller's department, we feel confident that inventories seldom get out of line. The one serious factor that we constantly attempt to guard against and which can be the biggest liability in any inventory system is the "personal" safety margin. For if the sales department decides to forecast just a little more than is needed, the production department makes just a little more to protect against a back-order position, and the purchasing department decides to get raw material to manufacturing sooner than required, imbalances created may be difficult to work down.

Appraising Profit in the Crude Oil Producing Industry

by WAYNE W. THOMAS

AS A COMPARATIVE MEASURE of efficiency or utilization of the use of capital, certainly the return on employed capital is a primary consideration behind every investment entered into for a profit. The application of the return on capital concept is usually found in two major areas. The first is as the investor's guide when deciding what type of investment to make, which industry to invest in, or which company within an industry to invest in. For example, the prudent investor will weigh the expected return on his invested capital against the risks involved when considering investments in government securities, bonds, industrial common stocks, public utility common stocks, etc. The second application is as a management tool from an operating standpoint. Of course, when used as a management tool, it must be adapted to the particular purpose it is to serve.

The discounted cash flow method is the one most widely applied to measuring of return on capital in oil financing. However, there are some difficulties in applying various techniques to the crude oil producing industry that will be demonstrated.

Basic Features of Oil Industry Financing

When we think of capital in the oil producing industry, we think of three types of capital or classifications of capital:

1. Risk or venture capital.
2. Development or investment capital.
3. Equity capital.

Risk or venture capital is the type of capital almost unique to the oil producing industry, attracted there by the sometimes tremendous return which can be enjoyed by the successful ventures. This is the capital which is used to finance the exploratory wildcat drilling ventures of the promoter-type of operator, who lacks the necessary capital or gambling instinct to go it alone, the prospects or wells to be drilled in an unproven area to finally establish whether or not all of the geological and geophysical indications of possible oil accumulations are correct. No one can be sure of finding oil

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until a well is drilled. The risk, speculation or adventure involved is enormous, with relatively small chances of finding an oil or gas field with sufficient supply to make it profitable.

When speaking of risk or venture capital, reference is made to the money to finance the drilling of wildcat oil wells where the odds are unfavorable, usually one chance in nine tries, sometimes even greater. Ventures such as these would hardly be considered bankable prospects.

Development or investment capital is that which is most frequently related to the financing of "development" oil wells — those drilled in or near an area where the wildcat well was drilled and oil or gas found. Here, the risks or odds are substantially reduced, generally speaking, because a producing zone is known to exist in the area and the primary risk is that of overstepping the boundaries of the accumulation area. Here, too, considerable risk is ever present. Bank loans are the normal source of this type of capital.

Equity capital is another concept of capital in the oil industry, no different from that in any other industry. This is, by and large, the tremendous capital equities represented in oil company ownership.

In any discussion of return on capital as applied to the oil industry, it seems appropriate to digress momentarily to investigate what attracts capital to the oil industry. Obviously, certain factors affect the return on capital in the oil industry as in any industry, plus some special attractions, not the least of which are tax treatment of depletion, intangible development costs and a hedge against inflation. In other words, if one has oil in the ground and knows where it is, then it is generally assumed that, like any other natural resource, it will retain its original value, adjusted for increases or decreases in the value of the dollar.

The large measure of risk and uncertainty, inherent in the oil producing industry, makes it impossible to apply accurately measurement standards such as those, for example, that might be employed in a manufacturing industry.

Nonfeasibility of Return on Capital Concept

In this discussion, it will be illustrated that the return on capital concept, which is a very practical and useful tool to measure the efficient employment of capital in many industries and miscellaneous investments, is not practical in measuring the return on capital in the oil producing industry. And one or two tools will be shown which are used instead by investment analysts to judge the proficiency of management in the oil industry.

In this illustration, a comparison is made of five oil companies which use various combinations of accounting methods. In order to highlight the effects of differences in the generally accepted accounting practices of these companies, let us assume that their

operations have been exactly the same, that they all have the same experience level and efficiency of management and that they have all had exactly the same degree of luck. Next, assume each company has done the following:

Produced and sold 100,000 barrels of oil for the year at $3.00 per barrel.

Realized $1,000,000 gross income from oil royalties from mineral fee leased to others. (This is rather an arbitrary assumption, but such situations do exist.)

Used straight-line depreciation of 6 percent on the composite basis.

Purchased for $100,000 an undeveloped five-year lease during the year and dropped none.

Spent $1,000,000 for intangible development costs (IDC).

Had exactly the same expenditures for:

1. Geophysical exploration ($400,000)
2. Dry hole costs ($50,000)
3. General operating expenses ($20,000)
4. Taxes other than Federal income taxes ($90,000).

Based upon these assumptions, turn now to the Comparative Statement of Income and Expense (Exhibit 1) and Comparative Balance Sheet (Exhibit 2) of these companies.

Company A, in Exhibit 2, with respect to its accounting does these things:

1. Capitalizes geophysical expenses on nonproducing leases until such time as the leases are dropped or expired (no expense for geophysical exploration on its statement of income and expense).
2. Capitalizes its intangible development costs and amortizes these costs on the basis of the estimated reserves on the unit-of-production method.
3. Capitalizes leasehold cash bonuses until the lease is dropped, expired or becomes productive (no charge to this year's earnings).

Then, examining the provision for depreciation, depletion and amortization, it will be noted that Company A has charged current earnings with $116,000, consisting of $6,000 depreciation, $10,000 cost depletion on producing leases and $100,000 amortization of intangible development costs. This amortization is based upon the assumption of a 1,000,000 barrel reserve and $1,000,000 of intangible development costs with a unit of $1.00 per barrel amortization on the 100,000 barrels produced this year. Taking also into account, for purposes of this example, the general operating expenses of $20,000 and dry hole costs of $50,000, total charges to the year's gross income amount to $276,000, with a net income before taxes of $1,024,000 or $1.02 per share or 8.5 percent on total ownership equity of $12,024,000.

EXHIBIT 1

Comparative Statement of Income and Expense
Year Ending December 31, 1960

	Company A	Company B	Company C	Company D	Company E
Gross income:					
Oil sales	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000
Oil & gas royalties	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Total income	$ 1,300,000	$ 1,300,000	$ 1,300,000	$ 1,300,000	$ 1,300,000
Expenses:					
Geophysical exploration	-0-	400,000	400,000	80,000	400,000
General operating expenses	20,000	20,000	20,000	20,000	20,000
Amortization, undeveloped lease	-0-	20,000	-0-	20,000	-0-
Dryhole costs	50,000	50,000	50,000	50,000	50,000
Taxes other than Fed. income	90,000	90,000	90,000	90,000	90,000
Provision for depreciation, depletion and amortization	116,000	1,016,000	116,000	116,000	1,016,000
Total expenses	$ 276,000	$ 1,596,000	$ 676,000	$ 376,000	$ 1,576,000
Net income (loss) before Fed. income taxes	$ 1,024,000	$(296,000)	$ 624,000	$ 924,000	$(276,000)
Net income (loss) per share	$1.02	($0.296)	$0.624	$0.924	($0.276)
Return on original capital:					
Net income ($)	1,024,000	(296,000)	624,000	924,000	(276,000)
Net equity ($)	12,024,000	10.704,000	11,624,000	11,924,000	10,724,000
Percent	8.5%	-2.76%	5.37%	7.7%	-2.57%

Comparative Balance Sheet
December 31, 1960

Assets	Company A	Company B	Company C	Company D	Company E
Current assets	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000
Property, plant & equipment:					
Lease and well equipment	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Producing leases	100,000	100,000	100,000	100,000	100,000
Producing mineral fee	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
Nonproducing leases	500,000	100,000	100,000	500,000	100,000
Intangible development costs	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Other assets & prepaid expense	200,000	200,000	200,000	200,000	200,000
Total	$11,900,000	$11,500,000	$11,500,000	$11,900,000	$11,500,000
Less:					
Reserve for depreciation	(6,000)	(6,000)	(6,000)	(6,000)	(6,000)
Reserve for depletion	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
Reserve for amortization IDC, leasehold, etc.	(100,000)	(1,020,000)	(100,000)	(200,000)	(1,000,000)
Net property, plant, equip.	$11,784,000	$10,464,000	$11,384,000	$11,684,000	$10,484,000
Total assets	$12,024,000	$10,704,000	$11,624,000	$11,924,000	$10,724,000
Liabilities and Capital					
Liabilities	-0-	-0-	-0-	-0-	-0-
Capital stock 1,000,000 shares @ $11 par	$11,000,000	$11,000,000	$11,000,000	$11,000,000	$11,000,000
Earned surplus (deficit)	1,024,000	(296,000)	624,000	924,000	(276,000)
Total liabilities and capital	$12,024,000	$10,704,000	$11,624,000	$11,924,000	$10,724,000

EXHIBIT 2

Next, refer to Company B. This company expenses all its intangible development costs against current year's earnings. It expenses its geophysical exploration costs as they are incurred. With respect to its $100,000 undeveloped five-year lease acquired during the year, it elects to amortize the lease cost over the life of the lease so amortizing one-fifth, or $20,000, this year. After Company B has charged its gross income with all geophysical exploration costs ($400,000), $20,000 amortization of undeveloped leaseholds (1/5 of $100,000) and $1,000,000 amortization of intangible development costs, plus the other charges which are the same as Company A, total charge to the year's gross income amounts to $1,596,000. The result is a loss of $296,000, equal to 29.6¢ per share, Company B's balance sheet shows owners' equity to be $10,704,000 as a result of its operations and methods of accounting, or 2.7 percent of the owner's equity ($10,704,000).

Company C capitalizes intangible development costs as Company A, expenses geophysical costs as Company B and capitalizes undeveloped leasehold

costs as Company A. Total charges against the current year's earnings amount to $676,000. The resulting net income of $624,000 equals to 62.4¢ per share, or a 5.37-percent return on capital, based upon the stockholders' equity at the year end of $11,624,000.

Taking another example, Company D, intangible development costs are capitalized as in Companies A and C, while the cost of its undeveloped leases over the life of such leases is amortized as in Company B, but it elects to capitalize its geophysical costs and write off $80,000 (1/5 of $400,000) each year over the life of the lease. In all, it has charged the current year's earnings with $376,000, resulting in a net income of $924,000 or 92.4¢ per share. Since the owners' equity was $11,924,000, the earnings represented a 7.7-percent return on capital.

Using Company E as a further illustration of why a comparison of the return on capital concept is not a very practical measure of performance in the oil producing industry, it is seen that, while Company E expenses IDC as Company B does and geophysical costs as incurred, as Companies B and C do, it capitalizes cash bonuses paid for undeveloped leases and writes them off when such leases are dropped or when they expire. Here we see that Company E's earnings have been charged with $1,576,000, resulting in a deficit of $276,000 or 2.57 percent.

Now, reviewing the given illustrations, it is obvious that the indiscriminate application of the return on capital concept to these oil producing companies would certainly cause confusion in the mind of any analyst. From the investor's standpoint, to compare companies in the oil industry with each other or with companies of other industries would require tremendous analytical detail over a long period of time with much technical interpretation. From the standpoint of management, even though it may have had very good luck in its discoveries and may have made the right managerial decisions, its future success cannot be judged entirely upon past performance. The measurement of return on capital indicated here is past history. Because of the high risks that are inherent in the oil industry, the management's decision in the next year to spend another $1,050,000 in a particular exploration may well end up as all dry-hole charges. Thus, the fact that Company A, for example, might in its second year have a $1,000,000 dry-hole cost that could reduce its earnings and return on capital to almost nothing would not necessarily mean that it did not have as good management as before but, possibly, that it was not as lucky. In other words, one year's figures do not form a broad enough basis for evaluating any except the very largest companies, whose operations are broad enough for the law of averages to work about the same each year.

Measurements Used in the Oil Producing Industry

If, as these illustrations have shown,

the return on capital concept is not practical to measure the performance of companies in the oil producing industry, what do investors, analysts, bankers and the oil producing industry itself use? In analyzing a particular company in the oil producing industry, some of the same criteria as used in other industries are employed, such as working capital ratios, for example. Cash flow (that is, net income plus depreciation, depletion and amortization) can often be indicative of the performance of an oil producing company.

Investment bankers and stock analysts frequently employ yet another measure referred to as cash throw-off. Though this term means different things to different people it generally denotes the cash flow, plus dry-hole costs and, sometimes, exploration costs. From the standpoint of estimating what management might be able to do and the possible result on the market price of stock, the amount of cash throw-off per share indicates the total cash resources at its command to use at discretion, whether it be for plowing back into the company or paying dividends and taxes, or some combination of these objectives.

The world famous geologist, the late DeGolyer once said that finding oil consisted of 90 percent luck and 10 percent technical knowledge and "know-how," but that he would not want to depend upon luck alone. When the speculator is attracted to the oil producing industry in the operations or wildcatting end of it, he is attracted in the same way a gambler might be, for that is what he is — he gambles the price of a well on the possibility of striking oil. If he is lucky and hits a big deposit, the return on his capital may be a thousand-fold or higher. If he misses, he has lost his entire capital. If he does hit, and many hits are marginal, the return on capital that he gets to keep is materially affected by the tax laws providing depletion allowance and intangible development costs as deductible expenses. If it were not for such provisions, much of the incentive to risk large sums of money in the oil industry would not be present.

There are certain tools used in the oil producing industry to measure performance of investment, but most are historical and after-the-fact. Reference is often made to the term "years to pay out." While this is more a time measurement of return *of* capital, it does serve a useful purpose in indicating how long the risk of getting back original capital may last. This procedure is more widely used in small oil companies than in large ones. In the large companies, it has been said by some that, once the money is spent on a particular project, why worry how fast it pays out when little or no control can be exerted on such progress.

In our company, we do maintain a continuous payout status record by properties, which includes the payout concept of return of capital. However, we incorporate not only the original

cash investment but also the cumulative additional investment and cumulative operating expense identified with each property to know, at any accounting period, the total cash outlay. Against this total, we accumulate the net cash return in order to ascertain what we call the percent of payout. Until a property reflects a 100-percent payout, we have not recovered our total cash outlay. When the payout percentage exceeds one hundred percent, we can then see to what extent we have received a return on capital invested.

To us, this percent of payout is useful from a management standpoint. We can say a property in a particular area returned the initial investment plus operating costs in two years and an additional 50 percent of such total expenditures in one additional year. Such data is taken into account when deciding whether or not to develop another area with similar characteristics, enlarge an area already developed, or acquire by purchase producing leases someone else has initially developed. Such comparisons do not consider income tax aspects nor depreciation but are believed to be useful as a guide to management decisions.

In Conclusion

The return on capital method as applied to a normal manufacturing concern does not work well in evaluating performance in the oil producing industry, due principally to:

1. The inherent large element of risk in the business, which causes violent fluctuations in financial results from year to year, except in the case of the very largest, long-established companies.

2. Wide differences in accounting methods used by the industry.

However, there are some yardsticks that analysts have found to be more reliable and usable for this particular industry, which have been illustrated.

The Small Order in Large and Small Business

by DAVID E. HENDERSON

THE PROCESSING of small orders is a business operating function rather than one of accounting. How, then, does it interest the accountant? Before answering that question let us define the small order. To some companies the small order is any order for less than five or ten dollars or one which calls for only one or two units; to others it means an order which must be handled at a loss; and to yet other companies, it is an order for less than the standard package in which the company sells its merchandise. Some small mail order companies have an average order value of under $5. Obviously they cannot spend $3 to process each one and still show a profit.

In any case the small order is, at best, on the fringe of profitability. This suggests the answer to the question posed. Any business transaction losing money or merely having an insufficient profit margin, must be the accountant's concern. He is called on to analyze unprofitable situations through cost accounting techniques. Then, if he has enough background to do so, he is free to make suggestions for turning loss into profit.

There are many reasons for small orders. Companies that market a product like electric mixers, water pumps or furnaces find they are in the repair parts business. And the repair parts business is essentially one of small orders. Then, too, emergency orders, which are received because the equipment which the customer purchased is down, nearly always fall into the small order class. Again, some merchandise is never sold in quantities. It is stocked as an accommodation for customers who order standard products in quantity. This is another situation which gives rise to the small order.

The foregoing are legitimate calls on the vendor. They are the kind of order which the vendor must handle, although often at a loss. There is also a kind of small order which the vendor is justified in not handling. This is the small order placed by the dealer who wants to avoid carrying inventory. In this way the dealer evades the responsibilities that go with being permitted to buy at a dealer's price. The vendor might be expected to take strong measures against such orders, but he generally is unable to do so because they are "buried" in all the other types of orders he processes.

Many companies recognize that the small order returns little, if any, profit. Some companies simply accept this as a melancholy fact and process all orders,

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large and small, together. Others, however, discourage small orders by making a minimum charge or they accumulate orders, without shipment, until a certain volume is attained. Still others refuse to handle the order at all, transferring it to a dealer near the customer.

The Small Order Technique

There is another approach to the small order. This is to treat it as something different from the large or regular order which accounts for the major share of the company's business. The small order is then processed as a separate type with distinct methods for processing, handling of the accounts receivable and order filling and stockkeeping. Companies which follow this approach have developed streamlined methods for handling small orders, that are satisfactory to the customer and adequate for carrying on the business. They can be used by a business of any size. Then, even in a large enterprise, the small order, if it returns some profit, need no longer be considered a "stepchild." Rather, it becomes a feature of company service and a sales aid in getting large and profitable orders.

Since it is easier to follow a specific procedure than generalizations, the small order is discussed below as it might be handled in a manufacturing company. Seven steps listed set small order processing apart from regular order processing. In large measure they define the small order. The steps follow:

1. Verify that the item ordered is in stock. Tally inventory removal.
2. Interpret the order directly on the customer's papers — check order number, customer's instructions, method of shipment, etc. Show selling price.
3. Write or type a four-part form showing only customer's name and address, date and total selling price.
4. Fill order, weigh, calculate postage and show billing on the four-part form.
5. Tape-list orders to get sales value.
6. Enclose two invoice copies of the four-part form with customer's papers in package. Apply the third copy to package as a mailing label. File the fourth copy (a card) as an accounts receivable record.
7. When customer sends in his payment, match file copy with remittance advice. Discard file copy and remittance advice.

Large and Small Order Procedures Compared

In the list which follows, the steps a normal or large order goes through in the average company are shown as Points 1, 2, 3, etc. Points 1a, 2a, 3a, etc., suggest the change necessary to bring the processing into the small order

format. Steps identical in both procedures are omitted. The intention is to point out some of the major steps which can be eliminated. The list follows:

CUSTOMER ORDER DEPARTMENT

1. *Registration.* The identification of the order by a reference number so that it can be located during processing.

1a. Eliminate registration. This step is needed only when it takes several days to process an order and the customer may inquire about his order before it is shipped. The small order is shipped within eight hours, so inquiries are almost non-existent.

2. *Analyze.* The identification of sales statistics information — customer class, product class, etc.

2a. Omit sales statistics. Small orders generate a small percentage of the dollar volume. The figure varies from company to company but it might be that 40 percent of the orders account for only 5 percent of the dollar volume. This might very well be omitted without distorting sales statistics noticeably.

3. *Credit check.* Establishment of the customer's credit.

3a. Orders are usually directed to the credit department to determine the customer's credit limit. Small orders almost always get routine approval. However, they ordinarily receive the same handling as any large order. Provide the small order processing facility with a Dun & Bradstreet reference. In case of doubt, the order can be sent c.o.d.

4. *Order transfer.* Transfer of the order information from the customer's order to the vendor's order form. This includes whatever interpretation is necessary to process the order in the vendor's plant. Frequently the order form to which transfer is made is a multi-set form. One or more copies serve as a shipping set. One copy may serve as acknowledgment to the customer.

4a. Interpret necessary information directly on the customer's order. Do not make up an additional order form. No shipping set or packing list is needed. Since the item ordered will get to the customer as soon as an acknowledgment would, no acknowledgment form is needed.

5. *File.* File copy of order.

5a. No files are maintained.

1. *Maintain ledger.* Debits (from the customer order) are entered on the customer's ledger page. Credits (customer's payments) serve to offset the debits.

1a. Customer's invoice and his original order (which serves as a packing list) are enclosed in the package.

Accounting for the Small Order

So far no mention has been made of provision in the small order method for obtaining (1) sales dollars, (2) unit inventory adjustment, or (3) standard cost dollars. The following are feasible arrangements:

1. *Sales dollars* can most easily be accumulated by tape-listing the amounts shown on the accounts receivable card.

2. *Unit inventory adjustment* which is necessary to make sure that an item is not oversold is equally simple. As each small order is processed, a tally mark on the inventory record will keep track of the balance on hand. An alternative is to use an open bin for items which will be involved in small orders. The bin is replenished periodically. No record of withdrawals is kept between times.

3. *Standard cost* of inventory removals can be developed from the record of tally marks or, if the open bin system is used, by calculating standard cost of removals every time the bin is replenished.

Accounts Receivable and Correspondence

A marked advantage of special processing of small orders is the elimination of unnecessary records. Apart from the accounts receivable card, which shows only the customer's name and the amount of the order, there is no record. If correspondence with the customer develops, he can usually return his order papers to identify the transaction. Otherwise, it is cheaper for the company to accept his complaint and make an adjustment accordingly. However, since the order is shipped within eight hours of receipt and is of small value (by definition), there is not much call for correspondence.

Handling the accounts receivable for small orders offers an opportunity for economy. Most firms set up some kind of ledger bookkeeping for regular receivables so that they have a record, not only of the sales amount but also of any deductions the customer might make — tax, shipping charges and the like. This kind of bookkeeping is necessary to support the correspondence which goes on between customer and vendor regarding a regular order. The

dollar value of small orders is insufficient to require any volume of correspondence. Small differences between the amount billed and the amount received can probably be written off more cheaply than they can be collected.

There are several ways in which the cost of these receivables can be reduced even below the cost of a bookless bookkeeping system. One is to send out small orders via c.o.d. Here the related stub or listing serves the same purpose as the receivable card made up as part of the four-part invoice form. It is either cleared by remittance from the transportation agency or by notice that the item was rejected and the article returned. For really small orders, say, under $1, it may not be worthwhile to set up either a bookless bookkeeping system or to use collection on delivery, the latter because of the c.o.d. charges. One way to handle so small an order is to enclose a coupon in the form of a return envelope showing on its face the amount to be returned. The coupon simply asks that the customer return the coupon envelope and the amount. He has only to put in loose change or stamps and return it to the vendor. No follow-up is made to see whether the customer ever returns the money or not. Even the use of a coin return envelope for orders under twenty-five cents can be questioned. It is doubtful whether a large company can process so small an amount without spending more than it receives. This size of order might better be sent gratis to the customer.

A discussion which has been saved for last concerns the customer who normally orders in large quantities but who also sends in small orders from time to time. The large order is carried on the regular accounts receivable ledgers of the vendor. The small order is part of a separate receivables operation. Will the customer object? Some experience has indicated that he will not. He will not always pay the small order separately, sometimes including it with other invoices covered by one check, but the receipt of two different types of billing does not appear to pose a problem to him.

One way to encourage separate payment is for the vendor to enclose a stamped, self-addressed envelope with the small order package. Many large companies do not make an extensive audit of their vendor's invoices for amounts under five or ten dollars. This almost automatic payment of small amounts lends itself ideally to paying the small order invoice separately from the vendor's large order invoices, especially if a return envelope is included. Should the customer have such an arrangement, it is only necessary for him to verify the invoice against the "in-ship" ticket, type out a check, enclose it (preferably with one copy of the invoice) in the self-addressed envelope, and drop it in the mail. The self-addressed envelope is strong inducement for the customer's accounts payable unit to "wrap up" the check-

writing transaction then and there and not to assign a vendor's number to a small order and match it with other invoices from the same vendor, awaiting payment. (The loss of statistics for a particular vendor is bound to be small in view of the low dollar limit placed on small orders.)

Applicable for Improved Efficiency

All too often a system has to accommodate widely divergent requirements. It has to make compromises that prevent an efficient operation at either end of the spectrum. The small order, contrasted with the large one, is just such a case.

The handling of small orders is admitted to be expensive under any circumstances. A company can discourage them, or even refuse to handle them. By and large, though, most companies do process them grudgingly, for the sake of customer relationships. The logical approach then is to handle them as efficiently as possible. If there is marked difference between the processing of small and large orders, in terms of cost, customer service or convenience, the setting up of two systems, as described in this article, is probably warranted.

EDP Control of Detail Parts in Airframe Manufacturing

by CHARLES T. BARRETT

As the competition for the defense dollar becomes markedly keener, control of the manufacture of detail parts gains in importance to the airframe manufacturer. The maze of complex detail parts required in today's manned and unmanned weapon systems constitutes a major portion of the cost of any weapon system. To achieve adequate control of the fabrication of detail parts, the management of General Dynamics at Fort Worth required that a rapid, accurate system be developed which would locate fabrication orders and give recognition to orders that had become lost. It was also desirable that the system spotlight overload areas, furnish a method of easily locating jobs for expediters and be an automatic prod to the man who could do something about fabrication shortage — the foreman.

Experience indicated that reports prepared from manual and punched card location control systems were delayed due to the time required for processing to the point that much of their usefulness was lost. To be effective, the fabrication status reports must be timely, available to the foreman at the beginning of the first shift each morning. The problem was further complicated by the tremendous number of parts continually in work — approximately 40,000 orders in process composed of 750,000 detail parts and assemblies being funneled through 20 acres of fabrication shops and subassembly areas. By utilizing the unique advantages available in electronic data processing, such a system was feasible in relation to the timely information required.

To devise a system to meet the requirements of management, we began our computer planning approximately five years ago, by bringing together accounting, industrial engineering and manufacturing personnel to analyze our major operating problem and to perform a careful appraisal of the equipment available. This investigation resulted in a management control plan which at the time sounded very "cloud nine." By management direction, the manufacturing portion of this over-all control plan was installed first.

The Fabrication Control System

Upon receipt of an order from the customer, the contracts department issues a sales order authorizing the affected departments to commence production. With the delivery of the sales order to the manufacturing control department, the shop order is prepared.

At this time a machine card is also prepared, listing the part number, schedule, quantity, work-in-process account to be charged and any other significant information. This card enters the order in the computer's file of work in process.

With the basic information stored in the computer, it is now necessary that

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a media be established to follow the part as it moves through the numerous steps in the manufacturing sequence and to transfer this information back to the computer. As the mechanical transmission of order location was a prime requisite of the system, the development and installation of a data gathering system was required. The media for transmission was required to be completely shop serviceable. This requirement was met by a punched card traveler, made of a rugged paper-plastic laminate.

The traveler is run through the ditto order reproduction process, picking up the control information from the order variable. Thus completed, the traveler moves with the job through each operation in the manufacturing sequence. The mechanical data gathering system consists of edge card readers located in the shop area, cable-connected to tape punches that are located adjacent to the computer. Each reader automatically transmits a two-digit station identification code and then the six-digit serial number read from the traveler.

To gather the information necessary for the fabrication control system to function properly, approximately 100 control stations are presently in use in the following areas: sheetmetal, processing, the machine shop, fiberglas, metalbond, various assembly areas, the material department, the order group, and other areas of the plant.

Each "making-area" control station is equipped with an edge card reader mounted on a standard metal bench. A single file or order travelers representing orders in work in the area is maintained adjacent to the reader, the current making-area report is attached to a clipboard mounted on the bench. When an order is received in the area, the traveler is fed through this reader.

Each morning the dispatcher checks the area report against the order traveler file and any discrepancy is noted on the report. If an order is incorrectly listed, a notice is forwarded to the fabrication control group, and the order is moved to an unlocated category. This action maintains the validity of the area reports and permits the follow-up of unlocated orders. Through this process almost all of the many orders identified as unlocated each day, are correctly located by subsequent order location transactions. The few that may remain unlocated are:

1. An actual loss — the shop order has been lost or destroyed before the intent of the order was materialized.
2. A paper loss — the shop order has been lost or destroyed after the intent of the order was accomplished.
3. A system error—the shop order location has been misplaced but the order is still in being. These seldom occur since the system is self-correcting. When the order moves to a new area, the new order location transaction locates the order in the correct control station.

Follow-up of all the orders that remain unlocated for 15 days is forced by the computer produced cards delivered to the using area. The manufacturing control department is responsible for determining the status of lost orders within 5 days. Previously, lost orders were not identified until the part went on shortage.

The Principal Reports to the Management

The principal reports furnished to management through the use of the fabrication control system as well as a brief description of each are as follows:

Making-area report (Exhibit 1) is the most important report furnished management, as it tells each shop area the jobs to work on each day, first, the jobs required to relieve shortages and, second, the jobs which have been in the area too long. The primary emphasis of this system is to push work through the shop. Therefore, each category of orders is arranged by number of days in station — the oldest jobs are highlighted daily.

The first-in-first-out emphasis gives shop management an effective measurement of schedule in relation to load. Though the ahead-of- or behind-schedule relationship of orders in a shop area was reported previously as a measure of shop performance, only with priority scheduling, has it become a true measure of the combined performance of all the elements involved — engineering, planning, tooling, material, manufacturing control and the shop. It is, however, not a true measure of the performance of any individual element constituting the all-over

DAILY LIST OF OLD JOBS AND JOBS ON SHORTAGE

REPORT NO. 23 DEPT 31 HYDRO PRESS M-DAY 255 PAGE 1

PROJECT	SERIAL NO.	PART NUMBER	ISSUE	IN WORK	COMP.	NO. DAYS	STOCK ON	PRI	
B-58	243004	4C244 6	253	254	284	1	3164	1	
B-58	236892	4E383 7	230	246	328	3	5503	2	
B-58	206086	4P1441 7	170	250	233	3	3163	2	
B-58	207754	4B089 27	184	241	304	2	3371	2	
B-58	991218	4FTB237 73	202	207	230	2	3640	2	
B-58	991218	4FTB237 74	202	207	230	2	3640	2	
TF-102	233244	8 75601 8	244	251	268	1	4105	2	
*F-106B	175282	8 76806 21	119	227	175		4609	2	
*F-106B	175282	8 76806 22	119	227	175		4609	2	
*F-106B	175295	8 76856 45	119	200	175		4609	2	
B-58	211196	4P1212 33	193	244	292	9	0000	4	
B-58	211196	4P1212 34	193	244	292	9	0000	4	
B-58	196778	4B10213 25	194	249	305	6	0000	4	
B-58	221180	4P1342 10	208	236	213	6	0000	4	
B-58	221180	4P1342 9	208	236	213	6	0000	4	
B-58	212388	4T2624 10	185	244	295	5	0000	4	
B-58	212388	4T2624 9	185	244	295	5	0000	4	
POD	244502	4N055 21	242	249	162	4		4	
*B-58	203470	4F468 15	194	240	295	3	0000	4	
*B-58	192594	4V1284	217	251	245	3	0000	4	
*B-58	229831	4V1327 9	213	251	275	3	0000	4	
*B-58	212780	4V411 15	193	251	310	3	0000	4	
*F-106B	233564	8 76515 10	215	225	279	3	0000	4	
B-58	243003	4C244 7	253	254	284	1	3164	4	CNCL
B-58	243005	4C244 8	253	254	284	1	3164	4	STOP

TOT PRI 1/00001 2/00009 3/00000 4/00015 1-3/00010 1-4/00025

RECEIVED COMPLETED BACKLOG

ORD/00013 PCS/000264 ORD/00004 PCS/000068 ORD/00063 PCS/001576

EXHIBIT 1

performance measurement. With this first-in-first-out concept, orders are issued in the correct schedule sequence. It is possible, with the system, to overnote established priority, and this is used to adjust for differences that develop beyond the issue point. Effective application of this concept has reduced shortages and also the effort required to control work in process.

First-time listings are identified on the report by an asterisk. Stopped or cancelled orders are clearly identified in the right-hand margin so they may be pulled out of work and held for disposition. The first order for a new part is identified by a unique symbol — the lozenge — printed just to the right of the priority classification. The priority classifications for all jobs appearing on the making-area report are: for a mandatory job, for store-room shortages and for old jobs which are approaching the store-room shortages rating.

Using-area report (Exhibit 2) is another daily report, listing by using area the current location of orders required to relieve shortages existing in the area. Those orders in a "held" category — held for tools, material or information — are easily identified and effective follow-up action is taken at once. The location of every shortage relief order

SHORTAGE REPORT

REPORT Q - STOCK ROOM 3005 BY DEPT MAKE — M-DAY 294

STOCK ROOM	PART NUMBER	NEXT ASSEMBLY	ITEM																									
3005	4C129 9	4C129	11	0701	A	D1	3	1	3000	001	239	236		231	18	16	11	15	12		235427	1
												240		229	11	14	11	11	07		240268	2
3005	4C1290501	4C129 0503	11	0701	A	D1	3	1	3000	026	237	250	251	258	8	7	70	1	91		244602	1
												250	251	258	8	7	99		99		244603	1
												236	241	245	12	7	98	1	78		235434	1
3005	4C131 9	4C131	11	0701	A	D1	3	2	3000	001	241	236		231	36	32	11	15	12		235429	1
												240		229	22	32	11	11	07		241934	2
3005	4C1611 9	4C1611	11	0552	3	D2	3	4	3000	3PR	243	218	223	230	20	7	70	4	98		238154	2
3005	4C304 10	4C304 2	11	0904	2	D1	3	1	3000	030	234	222	247	335	10	2	46	1	56		239413	2
3005	4C424 13	4C424 1	11	0701	2	D1	3	1	3000	031	231	215	226	296	8	1	96		76		238218	2
3005	4C431 11	4C431 1	11	0701	2	D2	3	1	3000	YST	244	230		326	14	2	37	1	06		222031	2
3005	4C433 23	4C433 801	11	0701	2	D2	3	1	3000	YST	244	222	226	246	7	1	35	1	53		238116	2
												230		326	10	1	32	1	07		222032	2
3005	4C444 17	4C444 5	11	0701	A	D2	3	1	3000	031	189	165	168	229	17	1	70	3	56		198227	2
												234		300	5	1	11	12	07		236044	2
3005	4C522 10	4C522 2	11	0701	3	D2	3	1	3000	YST	244	194	236	310	10	1	55	1	53		212799	2
3005	4C625 13	4C625 A3	1	0701	3	D2	3	1	3000	027	173	210	226	268	1	2	96	11	54		229222	1
3005	4C628 9	4C628	11	0705	2	D2	3	1	3000	030	235	239	244	288	2	1	54	2	55		240399	2
3005	4C659 19	4C659 3	1	0552	2	D2	3	4	3000	3PR	957	199	237	244	2	11	55	10	78	98	230911	2
												111	237	240	13	11	85	10	70	90	174197	2
3005	4C671	4C990 9	11	0552	2	D2	3	4	3000	3PR	229					8						
3005	4C827 9	4C827	11	0601	2	D2	3	1	3000	006	219	213	217	266	7	7	98	38	46		228819	2
3005	4C828 9	4C829	11	0601	2	D2	3	1	3000	017	220	213	250	266	7	4	56		55		228820	1

EXHIBIT 2

is listed, together with the number of days the order has remained in its present location. Individual follow-up action can be easily taken when required. Effective use of this report has resulted in a sharp reduction in the number of assembly area expediters.

Two categories of shortages are declared by the using-area report: Priority 1 (mandatory) identifies a shortage that is holding up assembly work, Priority 2 (zero) means an incipient shortage. Zero quantities are forecast twenty manufacturing days (one month) ahead of scheduled need. To declare a shortage, the stockroom initiates a shortage notice. The next morning, the shortage report with current open order status information is delivered to the stockroom.

Activity report, the third daily report, lists receipts of jobs, completions and backlog, as well as those ahead of schedule, behind schedule, and the total by shop area. The activity report is produced for each project with a summation for all projects. It is the generally used measure of fabrication shop activity.

The ahead-of- or behind-schedule relationship is here again identified, and again as only a measure of total system effectiveness not to be used to measure the performance of any single operating element.

One hundred and sixty-five manhours per week were required in the past to manually compile this one report now produced as a by-product of the fabrication control system.

Other daily reports. Other significant reports produced daily are:

1. A listing of part numbers on shortage with no shop order open. Correction of these discrepancies is the responsibility of a special order group.
2. Order locations by either part or serial number in response to inquiry. These inquiry lists locate orders requiring processing changes as well as orders to be stopped or cancelled.
3. Lists of programmed exceptions. These listings are extremely valuable in maintaining the validity of recorded data and in identifying system deficiencies.
4. Summaries of the making-area and using-area reports.

Follow-up of the Part Manufacturing Process

To better understand the operation of the fabrication control system, let us follow a typical part as it moves through the computer program.

The journey for every manufactured part begins in the tooling department. Here a parts control and release sheet is prepared and submitted to the keypunch section where the part number, serial number, schedule, quantity account to be charged and other significant information is inserted. When the machine card is delivered to the computer, the part is under computer control and the only manual actions will be those where labor or stockroom activity is reported. The computer will now maintain surveillance over the part number until the date on which its order point is reached. If overdue, it is ordered immediately.

Predetermined policies are stored in the computer and are used to determine

lead time based on the "department to make" to the "department to use" relationship. The part quantities to be ordered are determined from effectivity and usage, whereas work-in-process accounts to be used are determined from internally stored policy aligned with lots, class codes and sales orders. Material required in the manufacture of parts and sub-assemblies is determined by bringing together material requisitions and internally retained work-in-process accounts (work orders), quantities and material information retained from a material requirement system.

Through the issuance of material requisitions, the functions of the computer have been basically activated from internally stored policies. Labor costs, however, are fed into the computer from the manufacturing floor. Accompanying each order is the identification tag previously described, known as a traveler. Each traveler has a serial number and contains such data as part number, quantity ordered, start and completion dates, description and other significant information. Workers submit time cards referencing the traveler number, completely unaware of the work order information which is no longer shown on the traveler. The time reported by the worker is analyzed in lots by the computer and total lot cost is summarized internally. The hours thus accumulated are extended weekly at average departmental labor rates and are printed weekly for billing and other purposes. While distributing the labor charges, the computer determines the total labor cost of the order and calculates the piece cost.

A storeroom receipt tells the computer that the order is complete. At this point, the computer determines the difference between the quantity received and the quantity ordered. The computer also determines the effect of these shortages on next order date. When the planning or spares department limits or cancels the use of a part, the computer determines the effect of this action on the next order point and quantity. When one requirement is limited and others remain open, the computer is programmed to utilize any surplus parts through contract transfers to the open requirements and also furnishes the industrial accounting department with notification for cost transfers.

Order codes created in the ordering program are used in labor distribution in analyzing fabrication effort to show percent of effort expended on "good" parts, parts ordered because of previous manufacturing losses and parts built to replace those scrapped during assembly. The importance of this information to factory management and to estimating and quality control personnel is clear. In a very similar manner, losses due to engineering obsolescence are evaluated.

By bringing together the total requirement, inventory position, work-in-process cost and the investment to date, another computer program can determine the exact labor hours cost status within a contract. This is equivalent to making a shelf count of all the parts in an airplane and is done by the computer in less than two hours.

Whenever a part shortage occurs in the assembly stockroom, the stockroom clerk forwards this information to the computer. The computer replies with two reports: one tells the stockroom the fabrication cost centers where all of the shortages are located and the other tells each fabrication cost center all the parts in its area which are short and where they are needed.

Since the computer knows how many orders move through each cost center and how many hours are spent in each cost center, a report is furnished to fabrication management personnel telling them their average cost per piece each week.

After midnight, each day, the computer run is started. First, the new orders, location changes, completions and other order data transactions are used to up-date the master work-in-process file. While this up-dating is being accomplished, the activity report is calculated and arranged for printing. Next, the master shortage file is up-dated with additions and removals. The two files are then compared to produce the remaining daily reports—making-area, using-area, inquiries and exceptions reports. The reports are all printed on high-speed, off-line equipment and are in the hands of factory management by seven o'clock the following morning.

Advantages — Experienced, and Contemplated

Through the use of fabrication control system several proven advantages have resulted in the control of the fabrication of detail parts:

1. Shop management has been provided with an effective measure of performance to load.
2. A flexible priority system that is easily adjusted daily has been established.
3. Less effort needed to control work in process.
4. Less expediting effort required.
5. Less effort required to maintain the validity of an order.
6. Reduced shortages.
7. Shortened in-work span.
8. Improved accuracy of stockroom and ordering records.
9. Thorough follow-up of lost orders.

The use of serial number order identification, required by the fabrication control system, permits direct labor time pick-up by serial number rather than work order with mechanical allocation of time charges to work orders. Since we use multiple work orders on our shop orders, the serial number time pick-up is less complex and the mechanical allocation of charges much more accurate than in the previous method. This improvement alone resulted in a 45-percent reduction in timekeeping effort in the fabrication area. The mechanical allocation of charges to work orders is also being used by the material control system.

For the future we are contemplating an expansion of the fabrication control system to:

1. Handle variable information, such as the number of good parts produced, of parts rejected, etc.
2. Analyze quality control trends.
3. Record start and stop time on orders and mechanically compute detail parts labor costs.
4. Compute performance data by operator.

5. Mechanically calculate machine loading and forecasting.
6. Compute man-load by control area.
7. Compute fabrication cost-to-complete.
8. Mechanically analyze spares data: inventory, usage and configuration data.
9. Integrate ordering and inventory control into a complete system.

It is obvious at this point that any such technique which defines all of the constraints pertinent to production will probably be a competitive advantage to those who master it early. It is the most significant cost reduction tool for production since the automation of production processes. In job shop control, it may prove to be the most significant cost reduction tool. Our cost savings resulting from the use of electronic data processing in fabrication control now approach a million dollars.

Calculating Price Determining Factors — A Procedure

by LESTER J. SCHNEIDER

WHAT PRICE? is one of the most important questions confronting management today. This paper presents a procedure for a consistent pricing policy, including also the complete cost build-up and a new concept for determining the profit factor. Of course, not all types of business can use the same relationship of allocated costs in their pricing structure; the procedures described are most applicable to manufacturing companies. However, the principles behind the procedures could be applied more generally.

A pricing structure will be built up step by step for a hypothetical corporation which commenced operations approximately ten years ago. It manufactures a product named "X." Through research it is ascertained that there is the necessary skill and most of the capabilities required to manufacture another product called "A." There is a similar product on the market but the corporation has made several major changes which will greatly improve the product operation and render it adaptable to functions which it does not now perform.

The marketing department (or consultants) informed the management that the price range of the general product "A" hovers around $150. A complete analysis of the operational functions was made to give in full contrast the changes which were made in the new design. The marketing department studied the potential market and listed many additional adaptations for the product. Entry into the new market appeared feasible.

The engineering and manufacturing areas determined what raw materials would be needed for Product A. They also estimated the average labor involved for the first 100 units — three hours per unit in Cost Center 1, five hours per unit in Cost Center 2, and two hours per unit in Cost Center 3. The learning-curve percentage for labor on this product was determined to be 90 percent,[1] and was applied to the hours per unit for additional units as follows:

Number of units	*Hours per unit*			
	Cost Center 1	*Cost Center 2*	*Cost Center 3*	*Total*
100	3.0	5.0	2.0	10.0
200	2.7	4.5	1.8	9.0
400	2.4	4.1	1.6	8.1

[1] "Every time you double the quantity, the unit hours will be reduced by a fixed percentage." "The Learning Curve — A Basic Cost Projection Tool," Marvin L. Taylor, *N.A.A. Bulletin*, February 1961.

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Bids from vendors, received on all materials needed in various quantities, were compared to historical cost data to determine if an increase in material costs was necessary. Thus it was determined that the material cost would decrease as the quantity increased because vendor's "set-up" charges on each order would be amortized over a larger number of pieces. The unit cost would also be lower due to the vendor's quantity procurement scale, as shown below:

Quantity	*Material/Unit*
1 — 100	$52.00
101 — 199	46.00
200 — 399	43.00

Presuming that the labor hours and material dollars represent an accurate picture, determination of the manufacturing and/or production cost of the product can be made. To build up the manufacturing cost, the projected labor and burden rates were used as follows:

	Labor rate/hour	*Labor burden rates*
Cost Center 1	$2.00	200%
Cost Center 2	2.10	100
Cost Center 3	2.00	150

Since the corporation works on a three-shift basis, a shift premium has to be paid in addition to the normal labor rate. Because of this additional cost, $.03 is added for every labor hour in the build-up.

Manufacturing cost is determined by the following method:

Material	$
Labor (labor hours × hourly rate)	
Burden (labor $ × burden rate)	
Shift premium	
Manufacturing cost	$

Thus the manufacturing cost for Unit 100 and Unit 200 of product "A" would be built up as follows:

	Unit 100	*Unit 200*
Material	$52.00	$43.00
Labor		
Center 1		
$2.00 × 3.0 hrs.	$6.00	
$2.00 × 2.7 hrs.		$5.40
Center 2		
$2.10 × 5.0 hrs.	10.50	
$2.10 × 4.5 hrs.		9.45
Center 3		
$2.00 × 2.0 hrs.	4.00	
$2.00 × 1.8 hrs.		3.60
Total labor	20.50	18.45

Burden				
Center 1—200%	$12.00		$10.80	
Center 2—100%	10.50		9.45	
Center 3—150%	6.00		5.40	
Total burden		28.50		25.65
Premium—$.03 × 10.0 hrs		.30		.27
Manufacturing cost		$101.30		$87.37

After the manufacturing cost has been determined, certain additional factors must be considered in the cost build-up. The factors to be considered are replacement tooling, general and administrative expense, and warranty.

Going-in costs are not included in the cost structure, and are to be calculated separately. Going-in costs will include new tooling, and conversion and rearrangement expense. Conversion and rearragnement expenses are to be amortized over the first two years of production, and tooling over the first 5,000 units. At this time conversion and rearrangement costs are estimated to run $375,000 in material, labor, burden and equipment. Tooling is estimated at $25,000.

Replacement tooling is considered in the build-up. Replacing and/or refurbishing tooling is estimated at $200 per hundred units after the first 5,000 units are produced. Because $2.00 per unit is included in the costing structure, a portion of the new tooling is recovered on current production. Therefore, the first 5,000 units will have recovered 40 percent of the original tooling cost.

In the view of current and past experience, general and administrative expense has been determined at 10 percent of manufacturing costs.

A warranty factor must be considered for Product A. This was estimated to be 2 percent of the total cost, after tooling and general and administrative expense were added to the manufacturing cost.

The addition of these factors would appear as follows:

	Unit 100	*Unit 200*
Manufacturing cost	$101.30	$ 87.37
Tooling	2.00	2.00
General and administrative expense (10% of manufacturing cost)	10.13	8.74
Sub-total	$113.43	$ 98.11
Warranty (2% of sub-total)	2.27	1.96
Total cost	$115.70	$100.07

At this point the profit factor is determined.

Of all factors involved in arriving at the selling price, profit percentage factor is usually the least well founded. What is a reasonable return on total cost? Twenty-five, thirty-five or forty-five percent? Many times, a particular percentage is used because it appears to be a reasonable figure. However, to determine what the return should be, there are some factors that should be considered:

1. Replacement of equipment.

2. Return to the stockholders (dividends).
3. Long-term debt (bond) reduction.

Replacement of equipment. Because of today's rising costs of replacing the equipment, a company needs to recoup more than the depreciation effect on taxable income. Our corporation has a gross investment in plant and facilities of $18,250,000. The average annual depreciation is $2,555,000 or 14 percent. Planned expansion during the next year is $500,000. The replacement factor is as follows:

Gross investment in plant and facilities	$18,250,000
Planned expansion	500,000
Total investment including expansion	$18,750,000
Average annual depreciation	× 14%
Recovery through depreciation	$ 2,625,000

Return to stockholders (dividends) is another important factor to consider. Our corporation believes that a 6-percent return on the market value of the stock is necessary. Average total market value is $10,000,000, which means a return to stockholders of $600,000.

Reduction of the company's long-term debt. At the present time the corporation has a $5,000,000 bond issue due on January 1, 1970, and a sinking fund to which $250,000 will be contributed annually. When the bond issue is terminated, this amount may remain a factor to be used for research or other necessary costs not realizing an immediate revenue.

When the factors are brought together, we have a basis for determining return:

	(000)
1. Replacement of equipment	$2,625
2. Return to stockholders	600
3. Long-term debt reduction	250
Total return desired	$3,475

Because this return is on a net or after-taxes basis, it must be capitalized by 48 percent (based upon 52-percent corporate tax):

$$\$3,475 \div 48 = \$7,240$$

To determine the percentage of profit added to total cost, divide the capitalized return by the gross investment including planned expansion:

$$\$7,240 \div \$18,750 = .386$$

Using the total cost for units 100 and 200 previously given, a selling price can be determined:

	Unit 100	*Unit 200*
Total unit cost	$115.70	$100.07
Profit (38.6% of cost)	44.66	38.63
Unit selling price	$160.36	$138.70

Two methods can be used in preparing price lists which will ultimately be submitted to the customer, both involve use of the basic learning curve:

1. Determine a mid-point on the learning curve and compute the selling price at this point. In effect, the earlier units will bring less profit and units manufactured after this point will carry a larger profit margin.
2. Calculate the selling price at va-

EXHIBIT 1

Product A
Cost Analysis

Factor Description	Per unit for first 100 Planned	Per unit for first 100 Actual*	Units 1-100 Planned	Units 1-100 Actual	Per unit for first 200 Planned	Per unit for first 200 Actual	Units 1-200 Planned	Units 1-200 Actual
Material	52.00		5,200.00		43.00		8,600.00	
Labor Center 1	6.00		600.00		5.88		1,176.00	
" " 2	10.50		1,050.00		10.28		2,056.00	
" " 3	4.00		400.00		3.92		784.00	
Total labor	20.50		2,050.00		20.08		4,016.00	
Burden Center 1	12.00		1,200.00		11.75		2,350.00	
" " 2	10.50		1,050.00		10.25		2,050.00	
" " 3	6.00		600.00		5.88		1,176.00	
Total burden	28.50		2,850.00		27.88		5,576.00	
Premium	.30		30.00		.29		58.00	
Manufacturing cost	101.30		10,130.00		91.25		18,250.00	
Tooling	2.00		200.00		2.00		400.00	
General & administrative	10.13		1,013.00		9.12		1,824.00	
Sub-total	113.43		11,343.00		102.37		20,474.00	
Warranty	2.27		226.86		2.05		410.00	
Total cost	115.70		11,569.86		104.42		20,884.00	
Amortized "Going-in" costs								

* Divide actual costs for units 1-100 by 100 for actual average cost per unit.

rious intervals along the curve and submit this price list which will permit and induce the customer to purchase larger quantities. The intervals can be every 10, 50 or 100 units, or any increment desired. A point to be considered is that the selling price calculated for the number of units should be behind that particular point on the curve. The price should be calculated for the first unit within a given range, because every unit on the curve before this one will have higher costs. Thus the price for units 10-20 would be calculated on unit 10, etc.

Each of the two methods is acceptable. Of course, the particular product will have some bearing on the type of price list submitted to the customer.

After production has started, it is imperative that a close watch be kept on actual costs of the product. All areas must be analyzed and the production costs compared to the curve previously established. An analysis can be prepared prior to commencement of the study, which should be done during the pre-production period. The pre-printed form for the portion of the study relating to units 100 and 200 would appear as in Exhibit 1.

Gross investment in plant and facilities was used as the base for determining the profit factor, owing to its fairly consistent nature. If this base should change considerably, either up or down, every other factor would also change (except direct labor rates). However, if there is a small constant increase, the percent effect should not be disturbed because profit is expected on additional investment which would be considered in the depreciation factor.

The construction of total cost illustrated in this article can be varied in form after the manufacturing cost is calculated. The format is used for illustrative purposes only. General and administrative expense, warranty, and other expenses can be calculated on a cumulative basis if the company applies costs in this manner.

In summation then, three criteria must be considered for an intelligent pricing policy and pricing for return:

1. Practical use of the learning curve for manufacturing costs.
2. Analyzing the expected return.
3. Constant scrutiny of actual costs, by area, compared to hours and dollars used in the cost structure.

By using these three criteria and applying them to the specific return method, a consistent and practical pricing policy may be developed and maintained.

Preparation of a Monthly "President's Letter"

by DAVID D. MERRIMAN

INASMUCH AS accountants spend a significant part of their working life producing accounting reports for non-accountants, it is reasonable that we explore the narrative style of communicating such information as an important adjunct to our formal reporting. When we realize how much is customarily lost between what the gatherer of statistical and accounting information knows about a given situation and the relatively small part of that knowledge that is conveyed to the person who reads the resulting report, it is apparent that we have a problem well worth considering. Therefore, let us concern ourselves with the basic communications problem that is posed by the presentation of formal accounting information, specifically the monthly financial and operating reports that are supplied to the management group.

Alternatives in Reporting: Nos. 1 to 5

Responsibility for formal reporting may be discharged in various ways. Five more-or-less common patterns followed in presenting the month's financial statements to management are listed below:

1. The mere publication of an agreed-upon series of accounting reports.
2. Personal delivery of such reports, together with oral explanations of pertinent items, either in response to questions or volunteered.
3. Presentation of formal reports under conference conditions in which the management group examines the material and pertinent points are discussed by the group.
4. Use of graphic devices and other means for giving emphasis or to help make accounting terms generally more understandable to those receiving these reports.
5. The publishing of a summarizing report or letter (in addition to the regular statements) in which everything that should be gleaned from the formal financial and operating reports is reconsidered in context, and in which the significance of the important financial and operating changes during the month is presented in simple, straightforward language.

Here, then, we have several approaches to the discharge of reporting responsibilities. Too often the pattern actually followed in a company is not the result of studying the various possibilities available but is the carry-over

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of long-established habits that may not bear too close scrutiny. It is recommended that the accountant who exercises his reporting functions under such circumstances assume personal responsibility, not only for producing the agreed-upon set of reports or statements but also for thoroughly digesting this output, for interpreting it, for relating each important occurrence in the period's operation to the profit reported for the period, and for weighing the relative importance of each such happening during the period. This is what is meant, primarily, by Alternative 5 above. The important step to be considered is that of making the results of such considered analyses directly available to the management group. This can usually best be done in a summarizing letter or report prepared as soon as possible after the formal reports have been issued.

At our company, we issue such a report each month which we call the "president's letter." Copies go to all corporate officers. This effort is especially practical because it produces a number of very worthwhile benefits, not only for the persons who read the reports but also for the person responsible for their preparation. Inasmuch as this letter is in reality a comprehensive grouping of the important happenings during the month that affect the earning ability or financial condition of the company, it brings together what otherwise could be but partially understood information and allows for the proper emphasis on important items. Its preparation recognizes the fact that, in order to properly absorb the formalized content of financial statements, it takes an experienced and well-informed reader doing a deliberate job of examining such a statement, to grasp and understand the reasons for even the most obvious changes between reporting periods.

The format of such a "letter" should be flexible enough to cover any unusual events of significance, while also assuring the highlighting of the basically important financial happenings during the period. In our case, it is prepared by the controller and concerns itself with what he thinks are the major significant events reflected in the company's financial and other operating statements each month. It usually runs from six to eight pages in length. The letter is divided into two sections, "comments on operations" and "comments on financial condition." In it are compared the current and previous month's operations, together with a comparison of the current year to date against the previous year to date.

It should be understood that the letter being described is for an auto parts manufacturing company making several different product lines by volume production methods. Standard costs are employed and the company depends heavily on variance analysis for control. There are detailed departmental expense budgets for all departments.

Comments on Operations

The first section begins with introductory comments that cover any major occurrences that influenced operations during the month, such as a plant close-down for inventory-taking, the position of the month on the recognized "seasonal sales curve," any windfalls, or other special situations. Every effort is made to note and

identify any possible trend in sales, change in the relation of costs to selling prices, or other major movement.

Sales and profits by product lines are next for consideration. A recapitulation by product lines is presented showing "net sales" and "percent of profit" for each line, comparing the current and prior months. Explanations are provided for significant changes between periods in both sales volume and profit, such as changes in selling price or standard cost or any large changes in variance. The results of the relationship of sales volume to fixed cost for the period under review and other pertinent facts that such comparison brings to light are also discussed.

Identification of major factors contributing to gross profit is perhaps the most interesting part of this letter. This is accomplished, basically, by a rearrangement of the profit and loss information so that the relative size of the various income or expense items can be seen in direct comparison with each other, in terms of how they have increased or decreased profits as compared to the prior period. The following example illustrates this type of analysis:

Factors that Increase or (Decrease) Gross Profit

Changes in profit margins resulting from changes in sales volume and mix *between* product lines:

Product A	$ (2,800)	
Product B	2,200	
Product C	1,500	$ 900

Changes in profit margins or mix *within* a product line:

Product A	$ 3,400	
Product B	(10,800)	
Product C	7,000	(400)
		$ 500

Increase or (decrease) in standard gross profit

Increased controllable variance gain	2,100
Decreased volume variance gain	(500)
Decreased recovery from scrap	(700)
Increased inventory obsolescence	(400)
Increase or (decrease) in gross profit	$1,000

In the listing of the major factors involved in the change in gross profit as between the current and previous month or the year to date and the same period one year ago, the following two items need further explanation:

1. Changes in gross profit due to changes in sales volume and/or sales mix between product lines.
2. Changes in gross profit because of product mix within a product line or changes in any of the standard costs or sales prices within the particular product line.

Breaking down a change in the gross profit into these two categories for each product line can be of immense help in detecting and explaining any changes in gross profit. It is presumed here that the company's accounting routine produces at least a gross profit figure for each of its product lines. The analysis that has been outlined above is very often used to make this general breakdown between the effect of volume changes and changes in sales mix for total sales but it is seldom applied to individual product lines.

The first of these factors (when only total sales are considered) measures a profit change due to changes in sales volume alone. When applied to each of several product lines that make up total sales, this becomes a measure of two unseparated factors, namely, changes in sales volume and the gross profit margins enjoyed by the particular products. By way of illustration, it is obvious that a thousand dollar increase in sales of a product yielding a 20-percent margin is going to be more than offset by a thousand dollar decrease in sales of another product which carries a 30-percent profit margin. Thus, it would be possible with a lineup of products having various profit margins to show a change due to "volume" where there was no change in total sales volume but only a switch between the volume of several different product lines.

The following example is given for a hypothetical Product A:

Change in sales volume or mix between product lines

February sales	$340,000	
January sales	354,000	
Decrease	$(14,000)	at 20% standard gross profit = *(2,800)*

Change in standard gross profit (due to changes in selling price, standard costs, or mix within the line)

February standard gross profit	21%	
January " " "	20%	
Increase	1%	x $340,000 Feb. sales = *$3,400*

Net effect of Product A on change in gross profit	$ 600

As shown above, changes in gross profits due to volume, etc., are obtained by multiplying the change in sales between the two periods being considered by the percentage of standard gross profit applicable in the earlier of the two periods. This shows, in effect, the value of the increase or decrease in "volume" in terms of the earlier rate of profit. Also shown above is the method of evaluating changes in profit due to changes within the product line. Here the difference between the standard gross profit percentages in the two periods being considered is multiplied by the sales in the most recent period. This shows for the current period the increase or decrease due to the difference in profit rates. With this more detailed infor-

mation at hand, it is possible to be much more informative in describing the reasons behind the changes noted in standard gross profit and additional study in any particular instance may further pinpoint the items within the line that are affecting gross profit.

Analysis of Variances is the next sub-section of the first section of the letter. Even though other more detailed analyses of variances are issued in the company, the major changes are again pointed out here by comparing each major variance classification for the current month with the prior month, and explaining the significant changes between the two periods. Usually some comment is required for the following:

1. Controllable variances at each plant—material usage, labor efficiency and burden efficiency.
2. Volume variance by plants.
3. Price variances—advantageous or disadvantageous purchase experiences during the month.

Selling, administrative and warehouse expenses are covered next. These expenses frequently fail to get the same attention that plant operating expenses do. However, significant changes in the expense pattern are noted by carefully analyzing departmental expense reports, comparing periods, and so forth.

Comments on Financial Condition

After considering all the foregoing aspects of our profit picture, we prepare the second part of the letter. In this section are explained any significant changes during the period in any of the balance sheet accounts. Almost always discussed are the following:

1. Working capital position.
2. Receivables — especially their relationship to current sales as a gauge to the company's collection effectiveness.
3. Inventory investment, carefully compared to current sales and to the company's current position in the seasonal sales curve so that the effectiveness of inventory controls can be judged.

After coverage of the balance sheet items, cash receipts and disbursements are analyzed and a summary statement for both the month and year-to-date is presented. Significant relationships are considered and analyzed. All major sources of funds are related, where practical, to major dispositions so that cash-in-and-out financing is made more apparent to those who receive the routine financial reports.

What We Achieve — Communication

It will have been noted that the "president's letter" is not wholly narrative, although predominantly so. The figures are selective, not masses, and are explained by the text which, in turn, they illustrate. This is the basic idea which the letter seeks to implement: by means of a relatively easy-to-read letter the recipient is given a comprehensive representation of the overall financing and operating picture of the company.

Beyond These Covers

Books

Accounting Trends and Techniques

American Institute of Certified Public Accountants, 270 Madison Ave., New York 16, N. Y., 1961, 291 pp., $18.

Accounting usage is still marked by divergencies. This statistical summary analyzes the presentations represented by "600 industrial and commercial corporations" in their reports for years ending within 1960, "to which are added excerpts from and comments upon unusual accounting treatments found in 500 additional reports."

The Preparation of the Annual Report

Research Bureau, Inc., P.O. Box 68, Kensington Station, Detroit 24, Michigan, 1959, 175 pp., $15.

Replete with selected illustrations of annual reports — statements, pictures, accountants' opinions, narrative, use of color — this presentation is also expository, setting forth, for example, range of number of pages used in reports, types of covers, weight of paper stock, circulation, preparation procedure and techniques, etc.

The Cost-Minded Manager

John D. Staley, American Management Association, 1515 Broadway, New York 36, N. Y., 1961, 285 pp., $6.75.

Closing with a chapter recounting case histories of successful programs to reduce and control of costs, this text is a far-ranging, experience-based description of needs, ways and means to achieve lower levels and better results. Spotlight is thrown on labor and maintenance costs in specific chapters.

Capital Expenditure Decisions

Donald F. Istvan, Bureau of Business Research, Indiana University, Bloomington, Indiana, Paper Bound, 1961, 128 pp., $3.

Subtitled "how they are made in large corporations" and identified as Indiana Business Report No. 33, this offering is a study based on 48 such companies and 147 interviews with financial executives in their home offices. The two portions into which the study is organized deal, respectively, with "administrative procedures" and "economic evaluation." Lack of use of "refined" evaluation methods is found but five companies report exclusive use of time-adjusted rate of return, nine more employ it for expansion proposals, six others are considering its use and none report reverting to alternative methods.

Installing and Using an Automatic Data Processing System

John Peter McNerney, Division of Reseach, Harvard Business School, Boston 63, Mass., 1961, 315 pp., $3.

As might be expected, the data processed in the system reported in this case study is primarily accounting information. The evaluation of results relates to such achievements as sales and inventory control. The company illustrated through the stages of equipment investigation, selection and use is a paper converter.

Management Information Systems and the Computer

James D. Gallagher, American Management Association, 1515 Broadway, New York 36, N. Y., Paper Bound, 1961, 191 pp., $6.

This study covers a subject of central interest to accountants, but not particularly from an accounting viewpoint. "Organizing the System for Management Planning and Control" is the title of a main chapter. Two case studies are appended dealing, respectively, with American Airlines and Sylvania Electric Products.

Handbook of Automation, Computation and Control — Vol. 3

Grabbe, Ramo and Wooldridge, Editors, John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y., 1961, Chapter Paging, $19.75.

The preceding volumes of this series were devoted to (1) operations research and kindred topics and (2) computer design, terminology and use. Equally thorough and thoroughly technical, the present volume covers automatic control systems in manufacturing and processing industries, plus other material explaining how automatic control is achieved.

Data Processing Annual

Gille Associates, Inc., Book Tower, Detroit 26, Michigan, 1961, 320 pp., $15.

A variety of punched card and computer applications are described in this Volume III, which is indexed likewise to previous Volumes I and II. There is an extensive bibliography to the literature on computers and also a related publishers' directory.

The Audit and the Punched Card

A. Wayne Corcoran and Donald F. Istvan, Bureau of Business Research, Ohio State University, Columbus, Ohio, Paper Bound, 1961, 76 pp., $2.

Research Monograph No. 101, this presentation is based upon a survey of accounting firm practices in a particular geographic area in utilizing client tabulating equipment in expediting and achieving accuracy in audit steps. Numerous areas were found, from cash to taxes, where such assistance could be applied.

Operating Results of Food Chains in 1960

Wilbur B. England, Harvard Business School, Boston 63, Mass., Paper Bound, 1961, 50 pp., $2.

Reflecting operations of 53 companies with 7,300 stores, this study is now in its sixth year. There has been announced improvement in the currency of figures and the addition of a special section giving attention to an "issue of the year," identified as "food chain participation in general merchandise self-service department store type of operation." Statistics on operating results and expense by functions, related to 1960, form the substance of the study, with data mainly in terms of percentages.

Operating Results of Department and Specialty Stores in 1960

H. Lawrence Isaacson, Harvard Business School, Boston 63, Mass., Paper Bound, 1961, 161 pp., $6.

Also Bureau of Business Research Bulletin No. 161, this annual is the 41st "Harvard survey of margins, expenses, and profits of the department store trade." Tables are given first for "all firms combined," and then for volume-of-business classifications. Data is expressed throughout in percentages of relevant totals.

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